THE NAUTILUS

THE PILSBRY QUARTERLY
DEVOTED TO THE INTERESTS
OF CONCHOLOGISTS

VOL. 74
JULY, 1960 to APRIL, 1961

EDITORS AND PUBLISHERS

HORACE BURRINGTON BAKER
Professor Emeritus of Zoology, University of Pennsylvania

CHARLES B. WURTZ
Consulting Biologists Inc., 1009 Commercial Trust Building

R. TUCKER ABBOTT
H. A. Pilsbry Chair of Malacology, Academy of Natural Sciences

MRS. HORACE B. BAKER

PHILADELPHIA, PENNSYLVANIA

PONY PRINTING, UPPER DARBY, PA.

CONTENTS

Names of new genera, species, etc. in *italics*

Alabama 34, 83
Alaska 41, 91
American Malacological Union 78
American Museum of Natural History 91
Arctic 41, 91
Arizona 75
Atlantic, eastern 85
western 1, 26, 46, 56, 81, 120, 122, 131, 149, 162
Argentina 23
Australorbis 35
Balch, Francis Noyes, obituary 164
Bartsch, Paul, death 33
Biomphalaria 35
Bithyniidae 34
Brachidontes recurvus 1
Bulimulus 68
Button, Fred L., collection of 38
Canada 84
Catinella (Mediappendix) hubrichti Grimm 9, 109
Catinella (M.) pinicola Grimm 11, 109
Catinella (M.) vermeta 12
Cayman Islands 122
Cepaea nemoralis 82
Cepolis, Puerto Rican 142
Chlamys (Argopecten) rehderi G. Grau 15
Colubraria jordani, C. siphonata, C. soverbii 136
Colubraria xavieri G. Bruce Campbell 141
Contributors 39
Conus mus 81
Corbicula fluminea, introduction 114
Dates of Nautilus 33
Dinoplax gigas, parasitized by Odostomia chitonicola 87
Florida, marines 131
Foreign subscriptions 119
Genitalia, mounting of snail 32
Galacera Risso-Dominguez (Polyceridae) 56

Gyraulus arizonensis ... 37
Haiti ... 166
Helix pomatia ... 120
Hendersonia occulta ... 83
Heteropods as fish food ... 46
Hydrobiidae ... 34
Indiana ... 70
Indo-Pacific, south ... 15, 65
west ... 85
Illinois ... 120
Kansas ... 121
Kentucky ... 62
Littoridina sphinctostoma ... 158
Littorina littorea ... 120
Locomotion, temperature & light effects in slugs ... 125
Louisiana ... 157
Lyrodes doellojuradoi Parodiz ... 25
Lyrodes guarantica ... 23
Maryland ... 8, 102, 106, 160
Massachusetts ... 122
Mattox, Norman T., death ... 33
Mediappendix ... 123
Michigan ... 102, 109, 123
Mississippi ... 83
Mya arenaria, record size ... 120
Nelson, Charles G., collection of ... 39
North Carolina ... 13, 33, 166
Northwest Shell Club ... 121
Notes and news ... 33, 81, 119, 165
Odostomia, larval shell ... 85
Odostomia chitonicola on Dinoplax gigas ... 85
Odostomia dianthophila Wells & Wells ... 151
Odostomia dux ... 150
Okkelberg, Peter Olaus, obituary ... 119, 163
Orthalicus undatus jamaicensis ... 122
Pacific, east ... 18, 28, 41, 131, 136
south ... 15
Pallifera (Pancalyptus) fosteri ... 102
Pallifera (Pancalyptus) megaphallica Grimm ... 102

Pallifera (Pancalyptus) pilsbryi & subsp. *santaritana* Miles & Mead 76
Pisidium henslowanum 123
Planorbina 35
Pleistocene 18, 26
Pleurotomariidae 162
Pliocene 26
Polyplex Perry, type of 28
Pomatiopsis lapidaria 33
Post-Pleistocene 70
Probythinella procera 158
Pteropods as fish food 46
Publications received .... 40, (2) :iii, 123, (4) :iii
Puerto Rico 142, 166
Pyramidellidae, hosts 85
Quickella vagans 123
Rhode Island 82
Rissoella caribaea 134
Rissoella galba Robertson 135
Salinity, low 1
Schenck, Hubert G., death 118
Schwengel, Jeanne S., death 165
Slugs, light & temperature effects on locomotion 125
South Carolina 33
Sphaerium transversum 121
Survival, effect of low salinity 1
Tennessee 114, 166
Texas 37, 68, 82
Taphius 34
Thais 38
Truncatellidae 34
Unionidae 109
Vénus, voyage of 65
Vitrinizonites uvidermis 166
West Virginia 34
Wyoming 84, 95
Yunquea monteplatonis 166
Yunqueinae 166

INDEX TO AUTHORS

Abbott, R. Tucker 33, 33, 81
Allen, J. Frances 1
Baily, Joshua L., Jr. 28
Baker, H. Burrington 33, 34, 35, 38, 123, 142, 166
Beetle, Dorothy E. 84, 84, 95
Branson, Branley A. 38
Burch, John Q. 81
Campbell, G. Bruce 136
Champion, Merrill E. 164
Clench, William J. 82, 122
Dexter, Ralph W. 38, 119, 120
Editors 39, 166
Eyerdam, Walter Jacob 41, 91
Grau, Gilbert 15
Grimm, F. Wayne 8, 102, 106, 160
Heard, William H. 109, 123
Hubricht, Leslie 33, 34, 68, 82, 83, 83, 166
Ingram, William Marcus (Sinclair &) 114
Kaplan, Michael F. & W. L. Minckley 62
Karlin, Edward J. 125
Manager 119
Mead, Albert R. (Miles &) 75
Michelson, Edward H. 32
Miles, Charles D. & Albert R. Mead 75
Minckley, W. L. (Kaplan &) 62
Murray, Harold D. 121
Orr, Virginia (Robertson &) 85
Parmalee, Paul W. 70
Parodiz, J. J. 23
Rehder, H. A. 122
Rice, Tom 121
Risso-Dominguez, Carlos J. 56
Robertson, Robert 119, 131
Robertson & Virginia Orr 85
Russell, Henry D. 46
Schalie, Henry van der 119, 163
Sinclair, Ralph M. & William Marcus Ingram 114
Solem, Alan 38, 39, 157

Teskey, Margaret C. 78
Turner, Ruth D. 122, 162
Valentine, James W. 18
Wells, Harry W. & Mary Jane 149
Wells, John W. 26

Vol. 74 JULY, 1960 No. 1

THE NAUTILUS

THE PILSBRY QUARTERLY
DEVOTED TO THE INTERESTS OF CONCHOLOGISTS

EDITORS AND PUBLISHERS

Horace Burrington Baker, 11 Chelten Road, Havertown, Pa.
(Emeritus Professor of Zoology, University of Pennsylvania)

Charles B. Wurtz, *Consulting Biologists*
1009 Commercial Trust Building, Philadelphia 2

R. Tucker Abbott, Henry A. Pilsbry Chair of Malacology
Academy of Natural Sciences, Philadelphia 3

CONTENTS

Effect of low salinity on survival of the curved mussel, *Brachidontes recurvus*. By *J. Frances Allen* 1
Two new succineids from Maryland, with notes on *Catinella vermeta*. By *W. Wayne Grimm* 8
A new *Chlamys* from the south Pacific. By *Gilbert Grau* 15
Pleistocene molluscan notes, 3. Rocky coast faunule, Bahía San Quintín, Mexico. By *James W. Valentine* 18
Neotype for *Lyrodes guaranitica* Doering and description of a new species. By *J. J. Parodiz* 23
A Pleistocene marine mollusk in central New York. By *John W. Wells* 26
The type of *Polyplex* Perry. By *Joshua L. Baily, Jr.* 28
A rapid method for preparing mounts of snail genitalia. By *Edward H. Michelson* 32
Notes and news ..... 33 Publications received 40

$3.50 per year ($3.65 to Foreign Countries) $1.00 a copy.

Mrs. Horace B. Baker, Business Manager
11 Chelten Road, Havertown, Pennsylvania

Second-Class Postage paid at Philadelphia, Penna.

NAUTILUS:

A Quarterly Journal devoted to the study of Mollusks, edited and published by HORACE B. BAKER, CHARLES B. WURTZ and R. TUCKER ABBOTT.

Matter for publication should reach the senior editor by the first of the month preceding the month of issue (January, April, July and October). *Manuscript should be typewritten and DOUBLE SPACED throughout.* Proofs will not be submitted to authors unless requested.

Authors are charged for *engraving* blocks of plates and/or figures at cost, which averages $5.50 per page. But the minimum charge for each separate block is $3.00.

REPRINTS are furnished at printer's rates. ORDERS SHOULD BE WRITTEN ON OR ATTACHED TO FIRST PAGE OF MANUSCRIPT. PURCHASE ORDERS, when required, and shipping instructions, *MUST* accompany original order. Extra clerical or bookkeeping work because of delayed receipt of purchase orders will be charged for accordingly:

	2 pp.	*4 pp.*	*8 pp.*
50 copies	$3.00	$5.00	$8.00
100 copies	3.25	6.00	9.50
Additional 100s	1.30	2.00	3.00

Plates: Add $1.25 per plate.

[POSTAGE EXTRA]

The NAUTILUS is the official organ of the American Malacological Union. Information regarding membership in the Union may be obtained from Mrs. Margaret C. Teskey, Secretary, Route 2, Box 318, Marinette, Winsconsin.

EXCHANGE NOTICES

THE NAUTILUS

Vol. 74 July, 1960 No. 1

EFFECT OF LOW SALINITY ON SURVIVAL OF THE CURVED MUSSEL, BRACHIDONTES RECURVUS

By J. FRANCES ALLEN*
National Science Foundation, Washington, D. C.

Numerous investigators have been interested in the ability of various marine mollusks, especially pelecypods and gastropods, to adapt themselves to environments of changing salinities. Beudant (1816) found that such forms as *Ostrea* and *Mytilus* could resist the ill effects of exposure to fresh water better than those mollusks from the open sea. Chidester (1924) observed that *Mytilus edulis* is unable to keep the molecular concentration of the blood in low dilutions and probably dies as a result of asphyxiation. Federighi (1931) noted that the occurrence of death in an unsuitable medium may be the result of failure to adjust body fluids so that they are in equilibrium with the medium, to the toxic action of solutes, to the loss of essential salts, to the inability to carry on respiration and other processes which are essential to metabolism. The same author reported that a slight variation in salinity causes oysters to stop feeding. Pearse (1950) wrote that changes in salt concentration in both internal and external media change the respiratory rate in marine animals. In those forms which can not adjust, respiration becomes slower and finally ceases. He points out that they are better able to withstand slow changes rather than rapid changes in salinity and that they show toleration for varying degrees of dilution according to the concentration of the medium in their previous environment.

During the spring of 1951, there was a heavy mortality of the population of the curved or hooked mussel, *Brachidontes recurvus* (Rafinesque), on Hackett's Bar in the upper Chesapeake Bay. Since January, 1950, this area had been the subject of an intensive study of certain aspects of the biology, ecology,

* Work done while with the Department of Zoology, University of Maryland, College Park, Maryland.

TABLE I

BOTTOM TEMPERATURE AND SALINITY AT HACKETT'S BAR
JANUARY 16, 1950 THROUGH APRIL 16, 1951

DATE	TEMPERATURE ° C.	SALINITY ‰
1950 - Jan. 16	6.8	10.10
Feb. 16	5.7	11.60
Mar. 1	2.7	13.60
13	3.6	12.70
27	6.1	9.30
Apr. 10	7.0	5.20
24	10.3	7.50
May 8	13.6	7.90
22	13.3	10.10
Jun. 5	17.7	8.00
19	19.0	8.64
Jul. 3	22.5	9.64
17	23.5	9.63
31	24.5	8.51
Aug. 14	23.5	12.05
28	24.3	13.44
Sept. 11	22.8	10.75
25	20.4	15.41
Oct. 9	19.5	16.24
25	17.4	15.81
Nov. 13	11.6	13.28
27	7.2	8.86
Dec. 11	6.8	8.77
1951 - Jan. 2	3.1	7.48
15	3.6	9.47
29	2.1	3.84
Feb. 5	2.1	3.48
19	1.8	2.85
Mar. 5	5.3	6.91
19	5.2	8.21
Apr. 2	8.4	5.44
16	9.6	5.84

and growth of this species. Hackett's Bar is located on the western side of the Bay, approximately two nautical miles north of the mouth of the Severn River. It is ½ to ¾ of a mile off shore from Hackett Point, in water varying in depth from 2 to 35 feet.

Brachidontes recurvus is an important fouling organism present on oyster bars in the upper Chesapeake Bay and its tributaries, and it is also prevalent on bars situated in the Atlantic coastal areas from New Jersey (Nelson, 1928), Chesapeake Bay (Field, 1922), southward through the Gulf area (Chestnut, 1949; Engle, 1945 and 1948).

The relative abundance of a mussel population of an individual bar has been observed to vary from year to year. In some instances, a bar which is well populated one year will show a sparse population one or two years later.

From January 1950 through March 1951, the mussels on Hackett's Bar grew in large clusters attached to oyster shells. Monthly examinations of the population during this period showed little fluctuation either in the relative numbers of individuals or in their size variation. Dead mussels were not common and the mortality never exceeded 1 or 2% of the population.

During the same period, the salinity at Hackett's fluctuated considerably (Table I) as would be expected in any estuary. It reached its highest point on October 9, 1950, at which time it was 16.24 o/oo (parts per 1000), and its lowest value on February 19, 1951, was 2.85 o/oo. At approximately the same time the preceding year, February 16, the salinity was 11.6 o/oo, and during the spring the salinity did not go below 5.2 o/oo.

Following the low salinities of January and February 1951, a noticeable mortality was observed in samples collected from March 5 through April 16. A count of a bushel of oyster shells with attached mussels showed a mortality of 54.9%; that is, from a total of 628 mussels, 283 were alive and 345 were empty shells. A population survey of the Bar was made in October 1951, and at that time less than one percent of the population was greater than 35 mm. in length, the majority of the mussels at that time representing the set of 1951. In addition, many byssal threads attached to the shells indicated the recent disap-

pearance of these mussels.

Although the salinity value rose to 6.91 o/oo by March 5, the importance of the sudden drop in salinity, as a possible causative factor in producing mortality, was recognized. The effects of lowered salinity on oyster mortalities in the upper Bay are well known (Beaven, 1946; Engle, 1946). However, as Beaven (1946) points out, exposure to a brief period of lowered salinity seems to have little permanent effect on quality and survival of oysters.

In an effort to determine the relative importance of lowered salinity on the survival of the curved mussel, an experimental study was instigated in the laboratory to discover the effect of varying salinity values on their survival.

Appreciation is expressed to Mr. James B. Engle and the staff of the Shellfisheries Investigations of the U. S. Fish and Wildlife Service, Annapolis, Maryland, for assistance with the collection of the mussels and for the data on temperature and salinity from the area of Hackett's Bar.

Methods and materials

Oysters and attached mussels were collected from Hackett's Bar with a standard oyster dredge on April 16, 1951. Groups of mussels still attached to the oyster shells were placed in six-gallon glass aquaria containing water from just above the Bar and from the same area as that from which the mussels were taken. The water in the aquaria was diluted with distilled water following the technique of Fox (1936) so that the salinity in the various aquaria ranged from 0.9 o/oo to 6.5 o/oo. The aquaria, each being aerated continuously, were kept at room temperature so that the water varied from 18° C. to 21° C. The duration of the study was 36 days. Salinity was calculated from chlorinity by titration with silver nitrate.

Each aquarium contained 4 gallons of water and between 40 and 50 mussels. A representative population of all size ranges was involved.

Observations and discussion

A mortality was observed in any salinity below 6.00 o/oo with a constant increase in the percent mortality with decreasing salinity. The results are summarized in Table II.

These data show that in the salinity range, including 2.85 o/oo observed on Hackett's Bar, a 100% mortality occurred. Likewise, one may note, a mortality of 98% is associated with salinities

TABLE II

PER CENT MORTALITY OF *B. recurvus* ASSOCIATED WITH LOW SALINITY

SALINITY RANGE ‰	TOTAL NUMBER OF SPECIMENS	NUMBER DIED	PER CENT MORTALITY
6.0 - 6.5	135	0	0.00
5.6 - 5.9	184	11	5.97
4.6 - 5.5	144	22	15.22
3.6 - 4.5	216	212	98.01
0.9 - 3.5	165	165	100.00

TABLE III

NUMERICAL SUMMARY OF THE MORTALITY OF *B. recurvus* BY DAYS

SALINITY ‰	5.6 - 5.9	4.6 - 5.5	3.6 - 4.5	0.9 - 3.5
DAYS		NUMBER OF DEATHS		
3	3	5	64	80
5		5	16	24
7		7	32	20
10	2	3	48	8
12		1	24	12
14		1	20	12
16	3		12	8
19	1			1
TOTAL DEATHS	11	22	212	165

below 4.5 o/oo. This indicates that the critical low salinity for the survival of *Brachidontes recurvus* is probably 4.5 o/oo.

The greater number of deaths in all salinities occurred during the first 7 days. This was followed by a decreasing mortality extending over the following 2 weeks. The mussels surviving at the end of the 3 weeks period continued to live until the termination of the observations. These data are presented in Table III.

From examination of Table III, considerable individual resistance to low salinities is apparent. In the salinity range of 0.9-3.5, the greater number of early mortalities is associated with the lower end on the salinity range.

It should be noted that a rather striking correlation exists between the experimental data and the observed salinity and mortality on Hackett's Bar. On February 5 the salinity (Table I) had dropped to 3.48 o/oo which is well within the range of the experimental data where 98% mortality occurred. Thus, the mussels on the Bar were exposed to critical salinity conditions for a sufficiently long period to account for the observed mortality. The rise in salinity to 6.91 o/oo by March 5, continuing upward to 8.21 o/oo by March 19, apparently was insufficient to prevent the mortality in the population which had been observed during March and April. Therefore, a part of the observed mortality in the population was the result of the lowered salinity in January-February 1951. The lower percent mortality of 54.94 noted in the mussel population, may have been associated with the fact that lower temperatures prevailed simultaneously with the lower salinities (Table I).

It is well established that the curved mussel occurs abundantly in areas of low salinity as well as in areas of high salinity. *Mytilus edulis* exists quite satisfactorily along the ocean coasts and in habitats where the salinity is relatively high and which are not too distant from the influx, during tidal changes, of water of higher salinity (Dexter, 1947). In 1928, Dodgson noted that *Mytilus edulis* at Conway, Wales, could survive emersion during naturally occurring diurnal tidal periods in such extremely hypotonic solutions as 1.4 o/oo. He found that, at salinities below 16.18 o/oo, byssus formation was defective or did not occur; at 12.47 to 14.94 o/oo the closing of the valves was affected but that with a gradual reduction from the normal sea water to 8.75 o/oo the animals were able to survive and thrive. This same author indicated that these same mussels underwent no apparent harm

after being in water with a salinity value of 31.00 o/oo.

Fox et al. (1936) points out that *M. californianus* is confined to salinities from 17.00 o/oo and above. While this species can tolerate a salinity of 45.00 o/oo, values from 12.00 to 0.00 o/oo were fatal within 7 days.

Chanley (1958) reporting on the survival of various species of juvenile bivalves, states that *B. recurvus* from Chesapeake Bay subjected during studies at the U. S. Shellfisheries Laboratory at Milford, Connecticut, to different salinities, survived a salinity of 2.5 o/oo in temperatures ranging from 17.6° to 24.0° C. but that the gonad condition was poor. The same author who used specimens ranging in length from 17 to 47 mm. speaks of them as juveniles. The writer has found (unpublished data) that in the upper Chesapeake Bay, the mussels of this species at 20 mm. in length are in their second or third year of growth, and at 40 mm. are in their fourth or fifth year. Such a designation as juvenile appears to be somewhat questionable.

Although the curved mussel is widely distributed in the upper Chesapeake Bay and its tributaries where salinities generally range between 12 o/oo and 8 o/oo, its inability to withstand much lower salinities is obviously a contributing factor to its limited occurrence in less saline waters as well as its actual survival.

Summary

Experimental evidence indicates that salinities less than 6.00 o/oo contribute to the population mortality of *Brachidontes recurvus* in the upper Chesapeake Bay. Since the largest number of deaths was found experimentally to occur in salinities of less than 4.5 o/oo, this is the probable critical salinity value for the species. Apparently the rate of survival is somewhat higher during periods when the low salinities are accompanied by low temperatures. However, the susceptibility of this species to detrimental effects of decreasing salinity values can be considered as contributing both to the distribution and survival of the mussel.

Literature cited

Beudant, F. S. 1816. Mémoire sur la possibilité de fair vivres des mollusques fluviatilis les eaux saliene. J. Phys. *83:* 268-284.

Beavan, G. F. 1946. Effect of the Susquehanna River stream flow on Chesapeake Bay salinities and history of past oyster mortalities in upper Bay bars. Ann. Rept. Md. Bd. Nat. Res.: 1-11.

Chanley, P. E. 1958. Survival of some juvenile bivalves in water of low salinity. Proc. Nat. Shellfish. Assoc. *48:* 52-65.

Chestnut, A. F. 1949. The oyster industry of North Carolina and some of its problems. Address. Nat. Shellfish. Assoc.: 11-12.

Chidester, F. E. 1924. A critical examination of the evidence for physical and chemical influence on fish migration. Brit. J. Exp. Biol. *2:* 79-118.

Dexter, R. W. 1947. The marine communities of a tidal inlet at Cape Ann, Massachusetts: a study in bio-ecology. Ecol. Monogr. *17:* 262-294.

Dodgson, R. W. 1928. Report on mussel purification. Fish. Invest. London. *10*(1): 1-498.

Engle, J. B. 1945. The condition of the natural reefs and other public oyster bottoms of Alabama in 1943 with suggestions for their improvement. Spec. Sci. Rept. No. 29. Fish & Wildl. Serv., U. S. Dept. Interior. 42 pp.

—— 1946. Commercial aspects of the upper Chesapeake Bay oyster bars in light of recent oyster mortalities. Third Ann. Rept. Md. Bd. Nat. Res.: 134-140.

—— 1948. Investigation of the oyster reefs of Mississippi, Louisiana, and Alabama following the hurricane of Sept. 19, 1947. Spec. Sci. Rept. No. 59. Fish & Wildl. Serv., U. S. Dept. Interior. 71 pp.

Feredighi, H. 1931. The salinity death points of *Urosalpinx cinerea* Say. Ecol. *12:* 346-353.

Field, I. A. 1922. Biology and economic value of the sea mussel *Mytilus edulis.* Bull. U. S. Bur. Fish. *38:* 127-259. Bur. Fish. Doc. 992.

Fox, D. L. et al. 1936. The habitat and food of the California sea mussel. Bull. Scripps. Inst. Oceanogr. Tech. Ser. *4:* 1-64.

Nelson, T. C. 1928. Pelagic dissoconchs of the common mussel, *Mytilus edulis,* with observations on the behavior of the larvae of allied genera. Biol. Bull. *55:* 180-192.

Pearse, A. S. 1950. The emigrations of animals. The Sherwood Press, Dryden, N. Y. 210 pp.

TWO NEW SUCCINEIDS FROM MARYLAND, WITH NOTES ON CATINELLA VERMETA

By F. WAYNE GRIMM
Michigan State University, East Lansing, Mich.

Two new succineids of the genus *Catinella* (subgenus *Mediappendix*)[1] were found in collections of snails taken in Maryland in

[1] See N. Hj. Odhner, 1950. Proc. Malac. Soc. Lond. *28:* 200-209. *Mediappendix* Pils., 1948, and *Quickella* Boettger, 1939, are considered by Odhner to be subgenera of *Catinella* Pease, 1871, on the basis of the structure of the penis. In this genus, the sheathless penis ranges from the simple, primitive, non-appendiculate structure of *Catinella* s.s., through the knobbed structure of *Quickella,* to the strongly appendiculate form of *Mediappendix.*

1959. The few records available are limited to the Atlantic Coastal Plain region of that state. Type material has been deposited in the collections of the University of Michigan Museum of Zoology (UMMZ), the United States National Museum (USNM), the museum at Michigan State University, and in the collection of the author. Holotypes are in UMNZ.

CATINELLA (MEDIAPPENDIX) HUBRICHTI, new species.

Fig 1, A-E; pl. 1, F.

Shell translucent olive-yellow, rounded-ovate in shape (resembling a small *Oxyloma),* glossy, smooth, with unevenly spaced growth wrinkles; spire short, but acute; aperture slightly receding, broadly expanded at the base, occupying approximately .73 of the length of the shell. Compared with *C. vermeta* (Say) of similar length, the shell has about 1 whorl less, is more glossy, lacks a produced spire and deep suture, and is free of the earthy coating commonly associated with *vermeta.*

Dimensions in mm. and whorl counts approximate

Length	Diam.	Length aperture	Whorls
7.88	5.60	5.76	2½ type
9.28	6.24	6.80	2½ paratype
9.00	6.40	6.40	2½ paratype
6.55	4.60	4.40	2⅜ paratype
7.20	4.80	5.20	2⅜ paratype

Type locality: Near dump along Pocomoke River, w.s.w. edge of Snow Hill, Worcester Co., Md. Among wet leaves and cypress needles on mud near small creek (Grimm, Dec. 27, 1959). Type: Univ. Mich. Mus. Zool. no. 200684; paratypes UMMZ. 200685. This locality is situated in the south-central portion of the Delmarva Peninsula, which is east of the Chesapeake Bay. Also from the vicinity of Persimmon Creek at Md. Route 6, St. Mary's Co., Md. (March 29, 1959), and Patuxent River marshes at Leon, Anne Arundel Co., Md. (July 12, 1959).

Color of animal: In preserved specimens, the mantle over the lung is translucent whitish, heavily maculate with gray. Near the unmarked edge of the mantle, the maculations coalesce to form irregularly elongate spots. *A conspicuous, oblique black streak is situated near the posterior edge of the mantle.* A similar streak occupies an anterior dorsal position, immediately to the left of the kidney. Although the intensity of the maculation is somewhat variable individually, the presence of the black streaks seems to be a constant character in this species. Until more material is at hand, however, no definite statement can be made

concerning variability of pattern. The type lot is much less variable in this respect than any comparable lot of *C. vermeta* seen. The yellowish body and head are heavily spotted with dark gray, and the sole is unmarked yellow. In life, the background color is subtranslucent amber, and the skin contains minute flecks of orange visible under low magnification. The distinctive mantle pattern is visible through the shell, and the mantle appears to be edged with a thin line of greenish-yellow.

Genitalia: The genital orifice is in an irregularly curved fossa provided with a small flap-like, overhanging lobe. The brownish-gray hermaphrodite duct is prominently swollen and variously twisted. The divided talon is of moderate size and variable pigmentation, ranging from dark gray to cream white in color. The prostate is large, irregularly ovate in shape, and lightly dotted with gray. The vas deferens is of moderate length (a bit longer than in *C. vermeta)* and slightly thickened at the penial insertion, where it tends to form a loop. The penis is slender and fingerlike, bearing a somewhat longer and more slender appendix which branches off slightly below the middle. The penial retractor is thickened near its insertion, which is slightly below the point of entrance of the vas deferens. The retractor appears to have more fibers in the region of the appendix than are attached to the penis proper. Both the penis and the appendix are flecked with minute orange dots. The small, globose spermatheca is on a thin duct which is slightly longer than the penis.

Primarily, the penis and appendix of this species differ from those of *C. vermeta* (Say) and *C. vagans* (Pils.) in being much more elongate and slender. Because the size of the spermatheca, the appearance of the talon, and the degree of pigmentation and dilation of the hermaphrodite duct appear to be variable characters in the many *C. vermeta* dissected, they may have little or no bearing upon the specific identity of members of this genus.

The genitalia of the single specimen from St. Mary's Co. are reduced and threadlike, although they maintain proportions similar to those of the type lot. This specimen contained a small dipteran larva. The mantle pattern is almost identical to that of certain specimens in the type lot. The presence of a nematode cyst near the spermatheca of a specimen in the type lot did not appear to alter the appearance of the genitalia to a recognizable degree.

At the type locality, this species was associated with *Pallifera fosteri* F. C. Baker, *Deroceras laeve* (Müll), and *Pseudosuccinea columella* (Say).

This species is named for Leslie Hubricht, in recognition of his contribution to our knowledge of the land snails of the Atlantic Coastal Plain.

CATINELLA (MEDIAPPENDIX) PINICOLA, new species.

Fig. 1, F-K; pl. 1, C-E.

Shell small, ovate, thin and subtranslucent, somewhat calcareous; spire acute, proportionally longer than that of *C. hubrichti;* aperture rounded, expanded, occupying about .65 of the length of the shell; suture deeply indented, though not as deeply as in *C. vermeta;* whorls rounded, with a dull gloss, marked by uneven lines of growth. The lower whorls are of a light mustard shade, fading to whitish at the apex. In life, the shell is partially coated with dirt.

The shell of *C. pinicola* resembles that of *vermeta* but contains about ¾ whorl less in shells of similar size, is less slender, has a shorter spire and longer aperture proportionally, and is somewhat more calcareous than *vermeta*. Whereas the shell of *vermeta* ranges from golden brown to greenish-white in color, that of *pinicola* is of a more yellow shade.

Dimensions in mm. and whorl counts approximate

Length	Diam.	Length aperture	Whorls
7.17	4.85	4.48	2¾ type
8.00	4.97	5.00	2¾ paratype
7.20	5.00	4.18	2¾ paratype
6.96	4.40	4.16	2⅝ paratype
6.70	4.32	4.40	2¾ paratype
5.88	4.00	3.78	2⅝ paratype

Type locality: Near dump along Pocomoke River, w.s.w. edge of Snow Hill, Worcester Co., Md. Type: UMMZ. no. 200686; paratypes UMMZ. no. 200687. Under debris in open, loblolly pine woods, associated with prickly pear, *Smilax,* honeysuckle, etc. (Grimm, Dec. 27, 1959). Also from Royal Oak, Wicomico Co., Md. (Dec. 26, 1959) and Locks Swamp Creek at Md. Route 6, St. Mary's Co., Md. (March 29, 1959).

Color of animal: In preserved specimens, the mantle over the lung ranges from gray to blackish, and is spotted copiously with darker pigment. Where the irregularly dispersed pigment approaches the cream-white edge of the mantle, it coalesces to form irregular dark bands. A dark, elongate patch of gray-brown occupies the area immediately to the left of the kidney. The mantle maculation of this species resembles that of *C. hubrichti* closely,

but there is no posterior black streak, and the pigmentation forms more definite band zones near the edge. The head, tentacles, and sole are cream white, and the sides of the foot are peppered sparsely with gray.

Genitalia: The genital orifice closely resembles that of *hubrichti,* but the overhanging lobe is less prominent than in that species. The gray, hermaphrodite duct is slightly swollen and twisted. The talon is divided, thick, and dotted with gray. The prostate is as in *hubrichti,* but more heavily pigmented. The vas deferens is moderately long, *conspicuously thickened, looped, and dilated* near the point of entrance into the penis. The free end of this epiphallic loop is closely adherent to the upper lateral side of the penis, which is short and globose in shape and *bears no elongate extension beyond the middle.* The elongate appendix is thick and thumb-like. Both the penis and the appendix are shaded with dark brownish gray, the pigmentation being heaviest in the region of the vas deferens. The penial retractor is large, thick, and dilated near its insertion, which is above the epiphallic loop. The spermatheca is moderately large, globose, and placed at the end of a duct approximately as long as the penial complex.

The single specimen from St. Mary's Co., is smaller and lacks pigmentation in the prostate and talon. That from Wicomico Co. has an erect and strongly curved epiphallic loop.

This species is easily separated from others in the genus by the unusual aspect of the penis, vas deferens, and epiphallus. At the type locality, it was associated with *Triodopsis hopetonensis* (Shutt.), *T. albolabris* (Say), *Mesodon thyroidus* (Say), *Retinella indentata* (Say), *Zonitoides arboreus* (Say), *Hawaiia minuscula* (Binn.), *Anguispira alternata* (Say), *Gastrocopta contracta* (Say), *Strobilops aenea* Pils., *Pallifera fosteri* F. C. Baker, *P. mutabilis* Hubricht, *Limax marginatus* Müll., *L. maximus* Linn., and *Deroceras laeve* (Müll.).

Catinella (Mediappendix) hubrichti appears to be allied to the midwestern *C. (M.) wandae* (Webb) by the strongly bifurcate penial complex. Neither *hubrichti* nor *pinicola* appear to possess the "glandular" portion of the appendix described by Webb (1953a) for *wandae* and *oklahomarum.*

CATINELLA (M.) VERMETA (Say). Fig. 1, L-O; pl. 1, A, B.

For comparative purposes, the following data concerning *Catinella vermeta* (Say) are presented. Below are the shell measure-

ments of four examples from Ingham Co., Mich.

Dimensions in mm. and whorl counts approximate

Length	Diam.	Length aperture	Whorls
7.44	4.40	3.82	3½
8.53	5.08	4.56	3⅝
6.80	4.16	4.00	3¼
4.98	3.37	2.98	2¾

Specimens in the author's collection have been identified from the following counties in five states:

Michigan: Ingham, Monroe, Lapeer, Livingston, and Washtenaw counties. Ohio: Stark and Harrison counties. West Virginia: Ohio Co. New Jersey: Burlington Co. Maryland: Frederick and Charles counties.

These records, plus those published by Hubricht (1958) indicate that this species occurs from glaciated land in southern Michigan southeastward through the Ohio Valley on to the Atlantic Coastal Plain. *C. vermeta* has been widely confused with *Succinea,* and doubtless will be found to have a much wider range than is now known. Even when immature, this species is easy to recognize by the appendiculate penis. Until topotypes of "*Succinea avara* Say" are dissected and an anatomical identification established, the nomenclature of small American succineids cannot become fixed upon an acceptable point of reference.

The genitalia of *C. vermeta* do not appear to differ from the figures published for *C. vagans* (Pils.). The two are probably conspecific. Published records for *vagans* indicate its occurrence in North Carolina and New Jersey (Pilsbry, 1948), Kansas (Webb, 1953a; Leonard, 1959), Michigan (Lee, 1951), and Oklahoma (Webb, 1953b). Undoubtedly, the midwestern localities pertain to *vermeta*. The record from Lake Waccamow, N. C. (Pilsbry, 1948) is doubtless also *vermeta* (Leslie Hubricht, in letter). In spite of the evidence of conspecificity, the present author hesitates to place *vagans* in synonymy until shells of its type lot can be examined and topotypes dissected by him. Thus the taxonomic status of *vagans* becomes uncertain, in view of Hubricht's (1958) statement that tototypes of *vermeta* have a similar penis.

In southern Michigan, sexually mature *vermeta* appear in the latter part of September. They continue to increase in size until at least the first half of the following June. No further data on their development are available at this time. This snail appears

to prefer the muddy margins of ponds, lakes, and streams. Several lots were collected in ditches, marshes, and culverts in Michigan and Ohio.

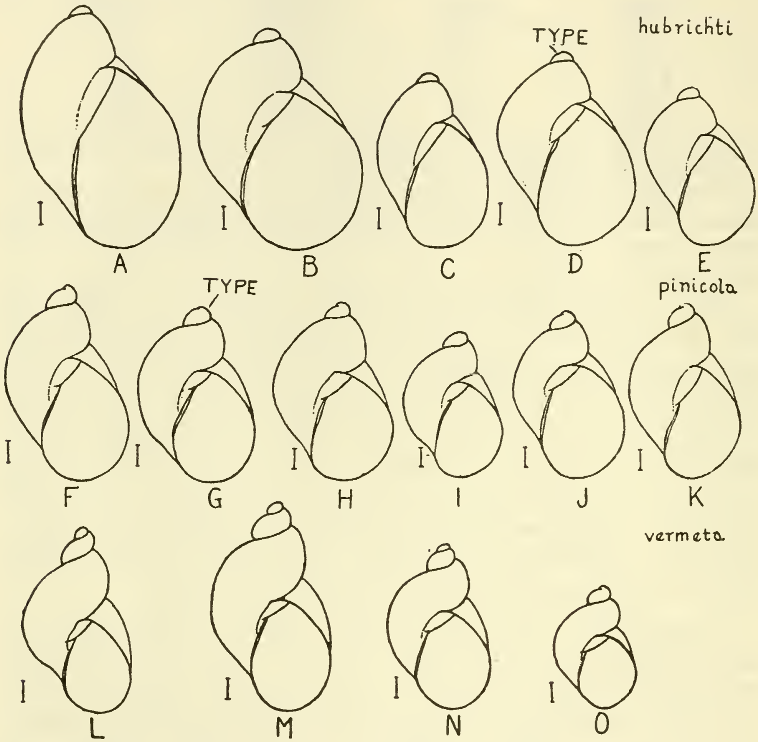


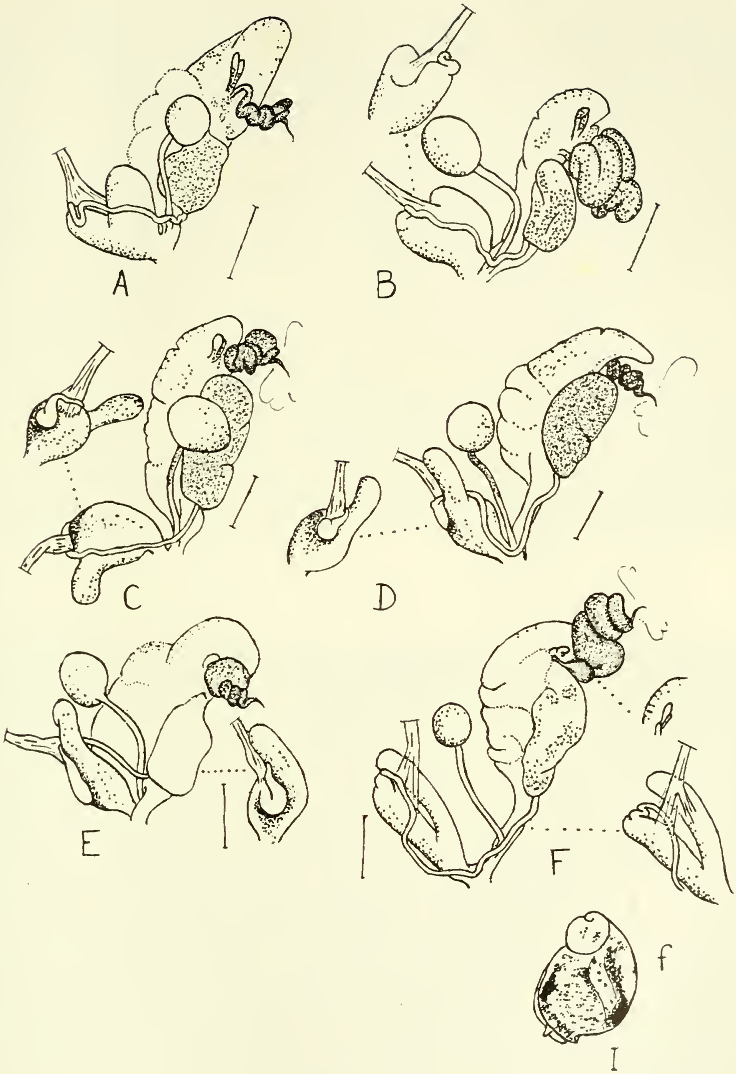
Fig. 1. Shells of *Catinella.* A-E, *C. hubrichti,* type and paratypes. F-K, *C. pinicola,* type and paratypes. L-O, *C. vermeta,* from East Lansing, Ingham Co., Mich. Scales = approximately 1 mm.

The mantle pattern noted for this species is variable. It generally consists of suffused gray zones or mottlings on a lighter background. The band zones are obscure, and never seem to be as prominent as in either of the two new species herein described.

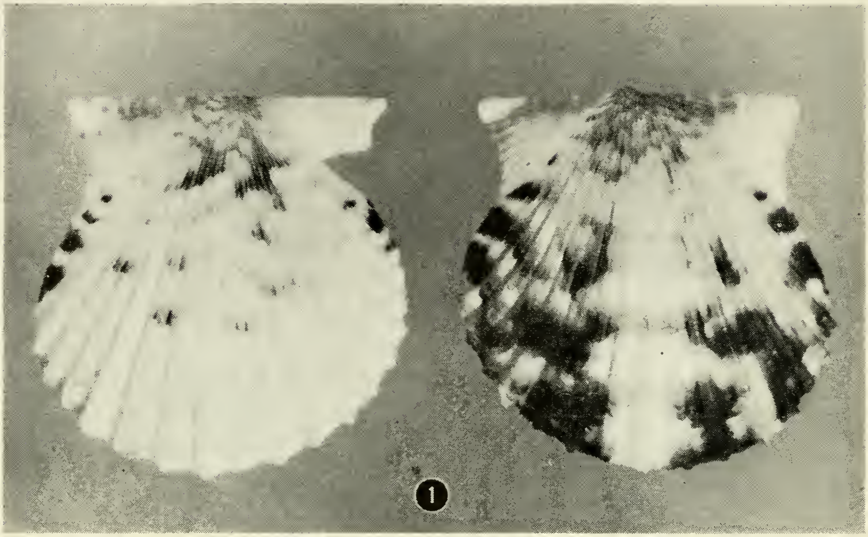
The author is indebted to Dr. Rollin H. Baker and to Dr. T. Wayne Porter, both of Michigan State University, for their constructive criticism of this paper.

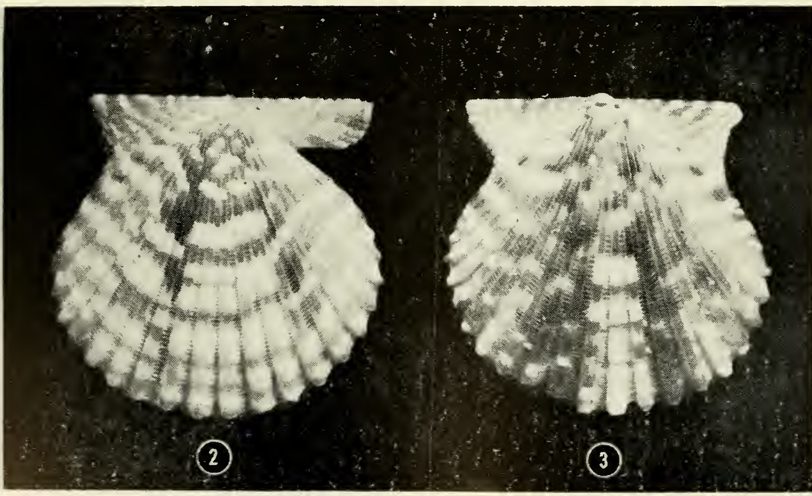
References

Hubricht, Leslie, 1958. *Quickella vermeta* and *Succinea indiana.* Naut. 72:60.



Genitalia of *Catinella*. A, *C. vermeta*, Frederick Co., Md. B, *C. vermeta*, Ingham Co., Mich. C,D, *C. pinicola*, from type lot. E, *C. pinicola*, St. Mary's Co., Md. F, *C. hubrichti*, from type lot; mantle pattern at f. Scales = approximately 1 mm.





Chlamys (Argopecten) rehderi Grau. Fig. 1; Holotype, right (left fig.) and left valves. Figs. 2, 3: Right (2) and left (3) valves from type lot.

Kagan, I. G. 1949. *Quickella* (family Succineidae) a new host for sporocysts of *Leucochloridium* (Trematoda: Brachylaemidae) in southeastern Michigan. Jour. Parasit. *35*:38-39.

Lee, C. B. 1951. The Molluscan family Succineidae in Michigan. Unpublished doctor's dissertation, Univ. Mich.

Leonard, A. B. 1959. Handbook of gastropods in Kansas. Univ. Kas. Mus. Nat. Hist., Misc. Pub. *20*:161-165.

Miles, C. D. 1958. The family Succineidae (Gastropoda: Pulmonata) in Kansas. Univ. Kas. Sci. Bull. *38*:1499-1543.

Odhner, N. Hj. 1950. Succineid studies, genera and species of subfamily Catinellinae nov. Proc. Malac. Soc. Lond. *28*:200-209.

Pilsbry, H. A. 1948. Land Mollusca of North America (north of Mexico). Acad. Nat. Sci. Phila. Monogr. 3, vol. *2*: (2) 521-1113 (see pp. 842-845).

Webb, G. R. 1953a. Anatomical studies on some midwestern Succineidae and two new species. Jour. Tenn. Acad. Sci. *28*:213-220.

—— 1953b. Additions to the pulmonate snails of Oklahoma (with notes on anatomical techniques). Proc. Okla. Acad. Sci. *34*:81-84.

A NEW CHLAMYS FROM THE SOUTH PACIFIC

BY GILBERT GRAU

Early in 1959, Dr. Harald A. Rehder, of the United States National Museum, sent the author six lots of Pectinidae he had collected during 1957 in the Society Islands and the Tuamotu Archipelago. It was immediately apparent that the specimens comprising a lot taken at Bora Bora, Society Islands, represented a species either new to science or very rare and little-known. After a thorough search of the literature on Pectinidae in general and on the species native to the central and western Pacific in particular, followed by extensive comparisons with series of related species in his collection, the author concluded that this species had not previously been described. Its description follows.

CHLAMYS (ARGOPECTEN) REHDERI, sp. nova. Pl. 2, figs. 1-3

Shell small, largest known specimen (a right valve) 9.5 mm. in height and 9 in length, nearly equivalve and nearly orbicular; moderately inflated; hinge margin as long as disk or nearly; beaks produced a little beyond hinge margin. Right valve moderately convex; 18 to 23 rounded ribs on central portion of disk, with 4 or 5 riblets flanking each submargin; interspaces about same width as ribs; entire disk covered with fine concentric lamellae, usually worn off tops of ribs. Anterior auricle long, with

5 to 7 pronounced and distinctly imbricated riblets, moderately wide fasciole, fairly deep byssal sinus, and ctenolium of 6 teeth; posterior auricle long, with 6 to 8 low, rounded and moderately lamellose riblets. Left valve slightly deeper than right, but with ribbing and sculpture identical; auricles long, as in right valve, and each with 5 to 7 low, rounded and moderately lamellose riblets. Interior of each valve fluted as result of external ribbing; fluting extending, although becoming progressively weaker, up into umbonal region; reverse surfaces of external interspaces angulate; prominent cardinal crura flanking ligamental pit of right valve, with corresponding depressions in left valve. Coloration: right valve white, yellow-white or pink, irregularly maculate with brown or yellow-brown, and often with wavy streaks of white which are interrupted by interspaces; left valve more profusely colored, having streaks or blotches of yellow-brown, pale to deep brown, or red-brown.

Holotype: Height and length 8 mm.; hinge line 7 mm.; inflation 3.75 mm. U. S. National Museum, no. 612201. Type lot: USNM. 612202.

Type locality: Tereia Point, Bora Bora Island, Leeward Group, Society Islands, French Oceania. All specimens collected in 13-16 fathoms by Dr. H. A. Rehder, April 4, 1957.

The type lot, which comprises the only known specimens of this species, consists of two complete specimens, one the holotype and the other a small shell 4 mm. in height and length, along with 16 right valves and 19 left, the smallest valve 5.5 mm. in height and length and the largest 9.5 mm. in height and 9 in length. Judging by the holotype, quite probably this species attains a height of 12 to 15 mm., perhaps even a bit more, and the author is attempting to secure as much material as possible from the south central Pacific in the hope of finding additional specimens.

In general aspect, this species resembles very young specimens of *Chlamys (Argopecten) gibba* (Linné) or *C. (A.) purpurata* (Lamarck). Such specimens of *C. gibba,* however, have a considerably thicker shell, greater inflation, shorter posterior auricles, stronger cardinal crura, and the interior is fluted for only a short distance from the ventral margin; in *C. purpurata* the shell is slightly thicker, the ribs shallower, the riblets on the anterior auricle of the right valve fewer and stronger, the posterior auricles much shorter, and the intercostal lamellae both weaker and less numerous.

The only previously recorded species from Polynesia referable to *Argopecten* is *Pecten nux* Reeve. It differs from the present

species in being much more inflated and in having tripartite ribs, very short posterior auricles and profuse lamellar ornament.

Since *Argopecten* is represented in the central and western Pacific by only three known living species *(nux* Reeve, *pelseneeri* Dautzenberg & Bavay and *corymbiata* Hedley), two erroneous references in the literature to extra-limital species referable to that subgenus should be mentioned here. Dautzenberg & Bavay (1912, p. 19) cited ? *Pecten (Aequipecten) aequisulcatus* Carpenter, giving two locations: "Banda." [Moluccas, Indonesia] and "Saleh-bay." [Soembawa (or Sumbawa) Island, Lesser Sunda Islands, Indonesia]; Bavay commented that he was reporting the species with some doubt. Campbell (1923, p. 40) cited *Pecten circularis* Sowerby from "Near Canton, and at Chung Chow, Hong Kong Territory, China." Obviously neither Bavay's nor Campbell's shells could have been examples of the eastern Pacific species they cited. Bavay's four specimens were all very young shells and found in 9 to 45 meters depth, indicating at least a small possibility that they may have been referable to this new species. Campbell's shells were very likely specimens of *pelseneeri* Dautzenberg & Bavay (1912, p. 8; new name for *Pecten rugosus* Sowerby, 1842, *non Pecten rugosus* Lamarck, 1819); *Chlamys (Argopecten) pelseneeri* (Dautzenberg & Bavay) has been reported from Japan, the Philippine Islands, Indonesia and Thailand (from the latter as *Pecten rugosus* Sowerby, by Lynge, 1907, p. 154).

Pectinidae of the group exemplified by such well-known species as *Ostrea gibba* Linné and *Pecten circularis* Sowerby have often been referred to *Plagioctenium* Dall or *Aequipecten* E. A. Fischer. The former is a junior synonym of *Argopecten* Monterosato; the latter comprises a few species distinct from *Argopecten* in being more orbicular, less inflated, and having radial striae. In addition to the type species, *C. commutata* (Monterosato) and the species here described, the following are also referable to *Argopecten: C. circularis* (Sowerby), *circularis aequisulcata* (Carpenter), *corymbiata* (Hedley), *flabella* (Gmelin), *flabella schrammi* (Fischer), *gibba* (Linné), *gibba nuclea* (Born), *gibba portusregii* (Grau), *irradians* (Lamarck), *irradians amplicostata* (Dall), *irradians concentrica* (Say), *noronhense* (E. A. Smith), *nux* (Reeve), *pelseneeri* (Dautzenberg & Bavay) and *purpurata* (Lamarck). A thorough discussion of *Argopecten,* its type species, synonymy and distribution will be found in the present author's

recently published monograph (Grau, 1959, pp. 93-96).

LITERATURE CITED

Campbell, A. S. 1923. Some common Chinese Mollusca. Jour. Entomol. Zool. (Pomona College, Calif.) 15, pp. 37-41.

Dautzenberg Philippe, and Arthur Bavay. 1912. Les lamellibranches de l'Expédition du Siboga. Partie Systematique. I. Pectinidés. *In* Siboga-Expeditie. Leiden. Mon. 53b, 41 pp., pls. 27-28.

Grau, Gilbert. 1959. Pectinidae of the eastern Pacific. Allan Hancock Pacific Expeditions (Univ. S. Calif. Press, Los Angeles), vol. 23 (complete), pp. i-viii, 1-308, 57 pls.

Lynge, Herman. 1909. The Danish Expedition to Siam, 1899-1900. Marine Lamellibranchiata. Mem. Acad. Roy. Sci. Lett. Danemark, ser. 7, vol. 5, no. 3. pp. 99-299, 5 pls., 1 chart.

PLEISTOCENE MOLLUSCAN NOTES, 3. ROCKY COAST FAUNULE, BAHIA SAN QUINTIN, MEXICO

BY JAMES W. VALENTINE
University of Missouri, Columbia

Numerous molluscan fossils have been recorded from the Upper Pleistocene of Bahía San Quintín, Baja California, Mexico, but the precise associations and abundances of species there have not yet been described. During a trip to gather data for the classic eastern bay shore localities, a small Upper Pleistocene fossil assemblage was collected from the western side as well (U.C.L.A. Locality 4186). Although it consists of only 31 molluscan forms, this faunule is of special interest as it contains a relatively large protected rocky-coast association. The fossil locality lies eastward of Kenton Hill and on the northern side of Mount Cenizia (both volcanic cones) and was situated on the leward side of a volcanic island during the Late Pleistocene time. The fossiliferous sediment is a rubble of angular volcanic cobbles and boulders with a poorly-sorted matrix that is chiefly an angular quartz-poor silt with minor amounts of fine angular sand and of clay, and contains abundant shell fragments and scattered shells. Evidently the steep volcanic slopes supplied both coarse and fine debris, while fine sediment was probably also transported alongshore by marine agencies. The sediment appears to be buttressed against ancient lava flows, but contacts are obscured by alluvial cover.

Previous and present work. Most of the Pleistocene fossils recorded from the Bahía San Quintín region were collected by C. R. Orcutt and G. D. Hanna. Orcutt's collecting began in the last cen-

tury, but he made a notable collection as late as 1919. Fossils from the western as well as the eastern side of the boy were in Orcutt's collections, but only the eastern assemblages have been carefully recorded. However, what appears to be the first record of a fossil from the western shore *(Melanella oldroydi* Bartsch, 1917) probably is based on specimens from an Orcutt collection, although the collector is not recorded. Orcutt mentioned several species from the western bay shore in his own short papers of 1921: *Hinnites gigantea (= H. multirugosus), Zirfaea gabbi (= Z. pilsbryi), Haliotis corrugata, H. fulgens, Macron aethiops,* and *Kellettia kellettii.* In 1926 Berry recorded the chitons in Orcutt's 1919 collections from the western side of the bay: *(?)Cyanoplax hartwegii, Mopalia muscosa, Chaetopleura gemma, C. languinosa, Ischnochiton mertensii, Callistochiton crassicostatus,* and *C. palmulatus mirabilis.* Manger also identified some of Orcutt's collections (1934) ; whether or not his list includes fossils from the western shore is questionable. Probably it does, judging from Orcutt's lists and remarks of 1921, but precise locality data were not recorded for this material.

Hanna visited Bahía San Quintín in 1922 and made large collections. He noted that the fossil assemblages from the west side of the bay were different from those along the eastern shore, but did not identify any species (1925) . Jordan (1926) recorded Hanna's collections from the eastern shore but mentioned only one form from the west *(Schizothaerus nuttallii).* The western localities of both Orcutt (at least in 1919) and of Hanna are said to be opposite the former village of San Quintín (Hanna, 1925, and Berry, 1926) . Complete faunal lists for the eastern localities may be found in Jordan (1926) and in Valentine and Meade *(in preparation)* who list all records not reported by Jordan.

Table 1 lists the fauna at U.C.L.A. Locality 4186. Only *Hinnites multirugosus and Callistochiton palmulatus mirabilis* have been certainly recorded heretofore from the western side of the bay. Probably this locality has not been represented in the literature, for it is rather too far north of the former village of San Quintín to be called "opposite." Because this locality is at essentially the same altitude as fossiliferous localities on the eastern shore, all these localities are probably nearly contemporaneous.

In table 1, those forms not qualified as to condition are repre-

sented in the collection by fairly well-preserved specimens although in large sets a few may be broken.

Table 1. Late Pleistocene Mollusca from the west side of Bahía San Quintín, U.C.L.A. Loc. 4186.

PELECYPODA	
Mytilus californianus Conrad	3 valves, broken
Modiolus cf. *M. capax* Conrad	2 beak fragments
Ostrea lurida Carpenter	51 valves
Hinnites multirugosus (Gale)	26 valves
Pododesmus macroschisma (Desh.)	8 valves
Chama pellucida Broderip	24 valves
Protothaca staminea (Conrad)	22 valves
P. tenerrima (Carp.)	1 valve
Macoma nasuta Conrad	21 valves
M. yoldiformis Carpenter	1 valve, broken
Semele rubropicta Dall	3 valves
Cumingia californica Conrad	11 valves
Cryptomya californica (Conrad)	54 valves
GASTROPODA	
Acmaea limatula Carpenter	3 chipped
Fissurella volcano Reeve	3
Diodora aspera (Eschscholtz)	10
Tricolia pulloides (Carp.)	2 broken, worn
Littorina scutulata Gould	5
Aletes squamigerus Carpenter	3 small segments
Bittium quadrifilatum Carp.	60
Crepidula nummaria Gould?	16 (laminar form)
Crepidula onyx Sowerby	1 apical fragment
Crepipatella lingulata (Gould)	3 chipped
Neverita reclusiana (Desh.) *s. l.*	1 worn
Ceratostoma nuttalli (Conrad)	3 chipped, worn
Acanthina lugubris Sowerby	2 apical fragments
Mitrella carinata (Hinds)	1 broken, worn
M. carinata gausapata (Gould)	1 worn
"Nassa" mendica Gould	5
AMPHINEURA	
Mopalia sp.	1 median valve
Callistochiton palmulatus mirabilis Pilsbry	1 median valve
ECHINOIDEA	
Strongylocentrotus purpuratus (Stimpson)	several fragments
CRUSTACEA	
Crab claw	1

Habitats and depositional environment. Insofar as substrates are concerned the faunule is composed chiefly of forms common today on rocky shores or on gravel or shell bottoms, and of forms that live in or on fine-grained substrates. The pelecypods among the rocky or shelly bottom forms are especially large and robust: 5 valves of *Hinnites multirugosus* are longer than 6 inches; a broken *Mytilus californianus* would measure over 5 inches when whole; and many valves of *Ostrea, Chama,* and *Pododesmus* exceed 2 inches and some 3 inches in length. Rock-dwelling gastropods also tend to be moderately large individuals of their respective species.

By far the most abundant species in the collection, represented by about ¼ of the total individuals, is the small *Bittium quadrifilatum,* which is especially common today on tidal mud flats (Bartsch, 1911; Emerson in Burch *et al.,* 1944-46, no. 54, p. 31) but is also known to live in inner sublittoral depths and has occasionally been dredged from as deep as 30 fathoms (Baker in Burch *et al., loc. cit.;* Smith and Gordon, 1948).

Most of the species range in depth from the littoral zone down into the inner sublittoral one to about 20 fathoms or more. However a few species are recorded only from the littoral zone; these are all rocky-shore forms, as *Fissurella volcano, Acmaea limatula, Littorina scutulata,* and *Acanthina lugubris.* These species are all rare in the collections.

That the locality was moderately protected from waves is suggested by the molluscan assemblage. Those species representing fine-grained substrates are forms found chiefly on tidal flats or in shallow waters in protected embayments or offshore below most wave action along exposed coasts. Such are *Protothaca tenerrima, Macoma nasuta, M. yoldiformis, Bittium quadrifilatum* and, commonly, *Cryptomya californica.* The rocky or shelly bottom component consists of species especially tolerant of quiet water, such as the species of *Ostrea, Chama, Pododesmus,* and *Ceratostoma.* Even *Mytilus californianus,* so characteristic of exposed rocky shores, lives occasionally at sheltered sites (fine large specimens live in Newport lagoon) or in shallow sublittoral depths. *Littorina scutulata* is chiefly an exposed shore form that is nevertheless found today well inside embayments at quiet water sites, in contrast to the sympatric *Littorina planaxis,* which is fairly well restricted to rough-water sites and is absent from the

collections at hand (see for example the ecologic data on *Littorina* in Burch *et al.*, 1944-46). In fact the vast majority of species characteristically abundant in Upper Pleistocene exposed, rocky shore assemblages, such as species of *Acmaea, Tegula, Homalopoma, Glans, Septifer,* and so on, are absent from this faunule.

To summarize these data, seemingly the association of niches represented by this assemblage is most likely to be found subtidally in shallow water along a fairly protected coast where fine grained sediments may collect but where rocks or shells are common. The numerous broken shells must in this view be ascribed to the action of carnivores or scavengers, rather than to mechanical breakage by wages. Mixing between biocoenoses seems to have been slight compared to most Late Pleistocene assemblages, for this assemblage is evidently the most "pure" example of a protected shallow water, rocky coast association yet recorded from the Californian Pleistocene. Usually such associations, are found intermixed in much larger sandy and silty bottom associations, and if exposed rocky-shore forms are also present the protected rocky-coast community is exceedingly difficult to identify.

Ranges and temperateure requirements. Components of the fossil assemblages from the eastern bay shore that are interpreted as autochthonous represent sandy-bottom, inner sublittoral communities and contain small southern and larger northern extralimital elements. Early workers gave most attention to the southern element (Jordan, 1926; Manger, 1934), but recently the northern element has been emphasized (Valentine, 1955; Valentine and Meade, *in preparation).* Two species of this northern element, *Macoma yoldiformis* (southern range end-point at San Diego) and *Semele rubropicta* (southern range end-point at "Tia Juana," probably the river) are present in the western faunule. A temperature regime somewhat different from that of today is suggested by these extra-limital species.

Description of fossil locality. U.C.L.A. Loc. 4186. Silty rubble exposed on the west side of the upper Bahía San Quintín on the bay shore about 25 yards north of western end of the old dam, now broached. Collected by John and Judith Van Couvering and James and Grace Valentine, December, 1956.

References

Bartsch, Paul. 1911. The Recent and fossil mollusks of the genus

Bittium from the west coast of America. Proc. U. S. Nat. Mus. *40*:383-414, pls. 51-58.

—— 1917. A monograph of west American melanellid mollusks. Proc. U. S. Nat. Mus. *53*:295-356, pls. 34-49.

Berry, S. S. 1926. Fossil chitons from the Pleistocene of San Quintin Bay, Lower California. Am. Jour. Sci. *212*:455-456.

Burch, J. Q. (ed.) *et al.* 1944-46. Distributional list of the west American marine mollusks from San Diego, California, to the Polar Sea. Conch. Club So. Calif., Minutes, nos. 33-93, pagination by issue, 3 pls.

Hanna, G. D. 1925. Expedition to Guadelupe Island, Mexico, in 1922. General report. Proc. Calif. Acad. Sci., ser. 4, *14*:217-275.

Jordan, E. K. 1926. Expedition to Guadelupe Island, Mexico, in 1922. Molluscan fauna of the Pleistocene of San Quintin Bay, Lower California. Proc. Calif. Acad. Sci., ser. 4, *15*:241-255, pl. 25.

Keen, A. M. 1958. Sea shells of tropical west America. Stanford Univ. Press, 624 pp., illus.

Manger, G. E. 1934. Some Pleistocene mollusks of San Quintin Bay and other localities from Lower California (Abstract). Johns Hopkins Univ. Studies in Geol. *11*:273-304, pl. 21.

Orcutt, C. R. 1921a. Paradise lost. West Am. Scientist *19*:18-19.

—— 1921b. Pleistocene beds of San Quintin Bay, Lower California. West Am. Scientist *19*:23-24.

Smith, A. G., and Gordon, Mackenzie, Jr. 1948. The marine mollusks and brachiopods of Monterey Bay, California, and vicinity. Proc. Calif. Acad. Sci., ser. 4, *26*:147-245, pls. 3-4.

Valentine, J. W. 1955. Upwelling and thermally anomalous Pacific coast Pleistocene molluscan faunas. Am. Jour. Sci. *253*:462-474.

—— and Meade, R. F. *(in preparation)*. Paleotemperatures of Californian Pleistocene Mollusca.

NEOTYPE FOR LYRODES GUARANITICA DOERING AND DESCRIPTION OF A NEW SPECIES

BY J. J. PARODIZ
(Carnegie Museum, Pittsburgh, Pa.)

Lyrodes Doering, 1885, was included by many authors in the synonymy of *Potamopyrgus* Stimpson until 1939, when J. P. E. Morrison established the differences between the two genera of the *Neotropical* region and New Zealand respectively. The status of *Lyrodes* finally was mentioned by Pilsbry in 1944. *Pyrgophorus* Ancey, 1888, is a synonym of *Lyrodes*.

LYRODES GUARANITICA Doering. Plate 3, figs. 1-5

After Doering's description, the type species, *L. guaranitica*,

was neither observed nor found. In 1924, A. Carcelles collected more than 100 specimens of a small *Littoridina*-like shell, from a locality about 200 miles north from Doering's type locality of *guaranitica*. Studying recently these specimens, I identified them with that species and now select a neotype (figs. 2-3), since all attempts to locate the type lot of the species, at the Zoological Museum of the University and Academy of Sciences of Córdoba, as well as in other places connected with Doering's work, were unsuccessful and, at present, the original material can be considered lost. Also, the original publication is today scarcely available, and the following is a translation of the description:

Doering, 1885, p.461: "*Lyrodes* n. gen. Shell subperforate elongate, oval-conic, thin, translucent, carinate, setaceous, with spiral lines. Animal with oblong foot, lyre-shaped (hence its name), with two retractile anterior lobes and posteriorly lanceolate; tentacles subconic, baculiform (rod-shaped); rostrum short." P.462. "*Lyrodes guaranitica* n.sp. Subperforate, conic-ovate, thin, pale brown, carinate and obsoletely spirally lined; spire conic, rather obtuse, 5½ convex whorls, the two larger with filiform carina and with spiral lines at the base (of the whorls); last whorl 2/5 of total length; suture deep, excavate; aperture oval, angulate above, peristome rectilinear, acute, continuous. Long 3.5 mm., width 1.75, apert. 1.25 x 1 mm."

P.463. "The species has many similarities with *coronata* Pfeiffer, being different by the absence of spines on the carina and by its spiral lines on the base of the whorls. Shuttleworth described a variation of *coronata* with these spiral lines. Carina and spiral lines are dark and in some specimens completely wanting, forming a series of variations similar to *coronata,* of which a noncarinate var. (*coronata crystallina* Pfr.) also exists, with intermediate stages."

"The animal is translucent, pale. Tentacles very short and /p.464/:thick, baculiform, thinner at the tips, *the eyes being at their base,* as two small dots. The tentacles are crystalline with a series of white points as pearls which give the aspect as if they were articulate" . . . "it is rare" . . . "if the var. mentioned for *coronata* belongs to our sp., it then has a vast zone of propogation."[1]

In the specimens observed (150) I found a great variability in outline and surface sculpture. Many are strongly carinate with spiral lines below the carina on the last whorl, in number from 2 to 10, but the many-whorled have a less strong carina. Others

[1] *Lyrodes coronata* (Pfr.) is known from Venezuela and Cuba to Central America and Mexico (see Martens, 1898).

have only a median carina without basal spiral lines or rarely with two lines above the carina. In our neotype, carina and spiral lines are visible also in the upper whorls, just under the protoconch, but in other specimens the carina is only an angulosity weaker at the top. Some specimens have only spiral lines without carina, and also the lines may be grouped in pairs, and finally others are without conspicuous spiral lines and, in this case, the outline of the whorls, especially the last one, is more convex, a character more noticeable in young specimens. The brown cuticle is rather thick, but under it the white shell still shows the spirals.

Neotype from Arroyo Riachuelo, near Corrientes city, Province of Corrientes, Argentina. Carnegie Museum accession 19130. Dimensions: L. 4.7 mm., maj. diam. 2.2, minor 1, last whorl 2.5, apert. 1.75 x 1.25.

Doering's specimens measured: L. 3.1-3.5, W.1.5-1.9, apert. 1.2-1.4 x 0.9-1.05 mm. Most of our specimens are longer, up to 5.5 mm. and the shape elongate. The "type" figured by Doering (fig. 4) has the last whorl relatively wider, as it appears in some of our young specimens.

The original type loc. according to Doering was "Lagunas riberenyas" (small lakes on the river coast) near Barrancas River or Guayquiraró. Actually, Barrancas is a creek, affluent of the Guayquiraró on the border of the provinces Corrientes and Entre Rios and very close to Paraná River, in Argentina.

The differences between *L. guaranitica* and *L. scotti* Pilsbry from the Pleistocene of Buenos Aires are obvious. Doello Jurado (1916) described a subspecies *scotti delticola* from the Paraná Delta (arroyo Tuyuparé) which has a more acute spire, with 4 to 6 spiral lines; aperture more oval, with columellar margin not concave, and with peristome not reflexed.

From the same province of Entre Rios, Doello Jurado collected in 1918 numerous specimens of a form which I found to be distinct from *guaranitica* or *scotti:*

Lyrodes doellojuradoi, **new species.** Plate 3, figs. 6-11.

Diagnosis: Shell elongate, imperforate but slightly rimate, not carinate, with 6 convex and rapidly descending whorls of irregular growth and well marked by a sinuously developed suture. Surface of smooth aspect but microscopically crossed by spiral lines and light axial growth wrinkles. Aperture small, angulate above, outer margin moderately expanded and columellar slightly produced to the left; the inner upper part of the col-

umella is rather wider as shown in fig. 9. The length of the shells is little more than double the greater diameter. Dimensions of holotype: L.4.9, W.1.8, last whorl 2.21, apert. 1.2 x 1 mm. From Gualeguaychú River (at the bend of the river before emptying into the Uruguay) at Gualeguaychú city, S.E. of prov. Entre Rios, Argentina. Carnegie Museum, acces. 17191.

This species is widely variable and recalls the shape and variations of *Littoridina hatcheri* Pilsbry of southern Patagonia. Some specimens are shorter and of a more regular *Littoridina*-like shape (fig. 10) and in such cases resemble *Lyrodes petenigensis* (Gould) as figured by Pilsbry (1911, pl.41c, f.12), but this is a green colored species from brackish waters of Rio Janeiro Harbor. The sutural line is often notched with depressions which deform the shape of the median whorls (fig. 11), and also the axis is sometimes curved.

It is interesting to point out the great similarities that *Lyrodes* shows with some Pliocene and Pleistocene genera from North America, as *Calipyrgula* Pilsbry and *Durangonella* Morrison, (compare the type of *Lyrodes* with *Calipyrgula carinifera* Pils. from the Basal Tulare Formation of California, and our new species with *C. pecosensis* Leonard and Ho from Kansas Pleistocene, recently described in the NAUTILUS). Future research may uncover closer relationship among these genera.

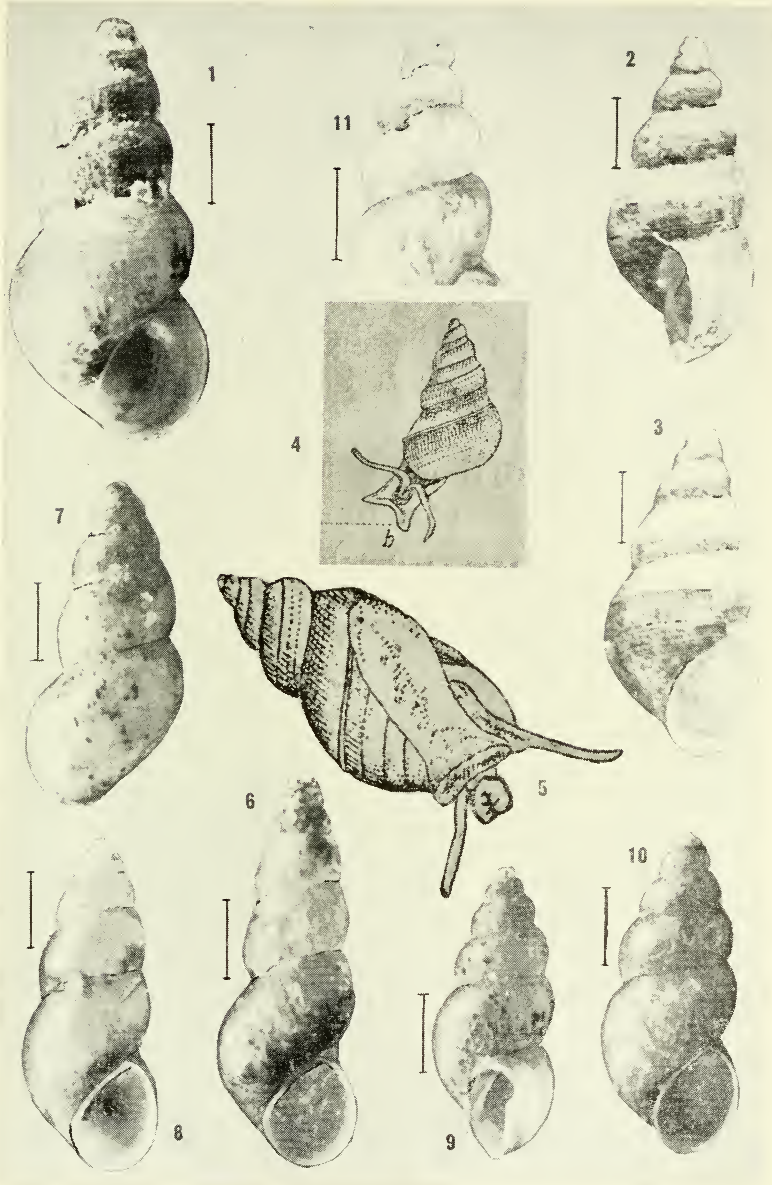
REFERENCES

Baker, H. B. 1930. Occ. Papers Mus. Zool. Univ. Mich., No. 210.
Doello Jurado, M. 1916. Physis *2*(10):178-179.
Doering, A., 1885. Bol. Acad. Nac. Ciencias de Cordoba, *7*:457-474.
Leonard, B.A. and Franzen, D.S. 1946. Bull. Univ. Kansas, *31* (1)-5:107-114.
Leonard, B. A. and Tong-Yun Ho. 1960. Naut. *73* (3) :110-113.
Martens, E. von. 1898. Biol. Centr. Amer., p.434.
Morrison, J. P. E. 1939. Naut., *52* (3) :87-88.
Pilsbry, H. A. 1911. Princeton Patag. Evped., *3* (2) V.
—— 1944. Proc. A.N.S.P. *96*:144.

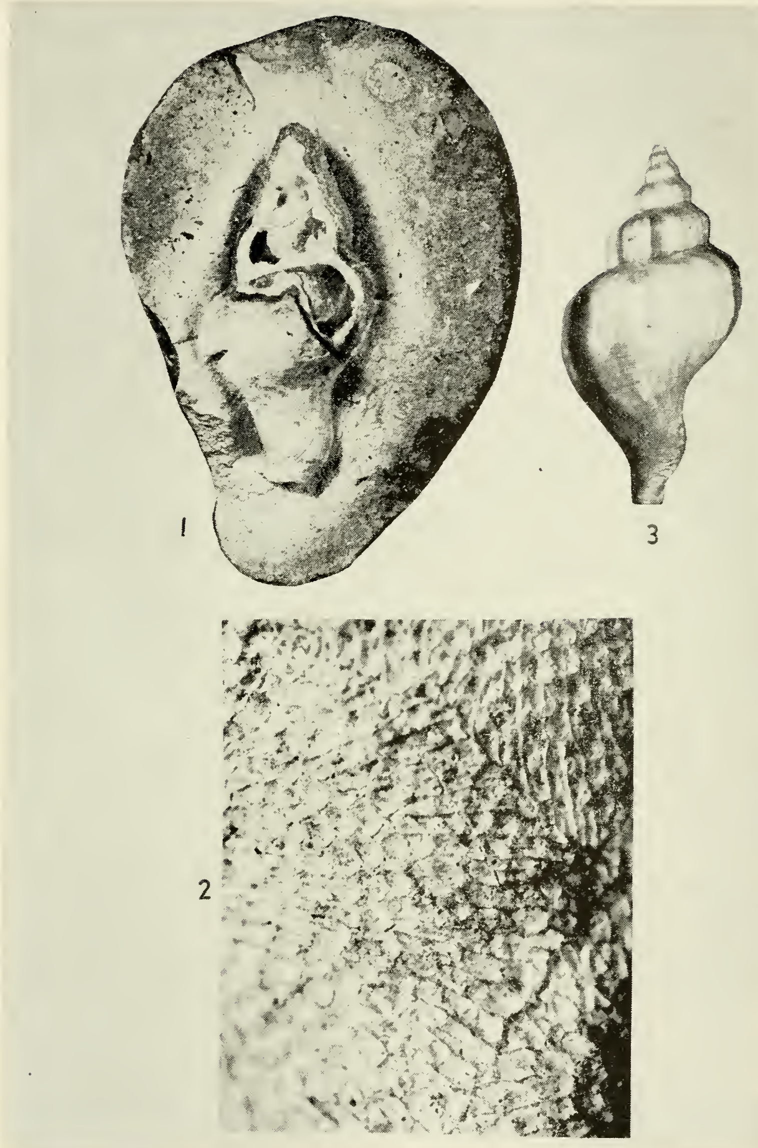
A PLEISTOCENE MARINE MOLLUSK IN CENTRAL NEW YORK

BY JOHN W. WELLS
Cornell University

A few years ago a fossiliferous concretion was found in the Wisconsin drift near Ithaca, New York, by John Cole, son of Dr. L. C. Cole of Cornell University. They kindly donated this curious specimen to the paleontological collections of the Cornell De-



Figs. 1-5, *Lyrodes guaranitica* Doering: 1, large specimen; 2-3, neotype; 4-5, Doering's original figures. Figs. 6-11, *Lyrodes doellojuradoi* Parodiz: 6, holotype; 7-10, paratypes; 11, upper whorls showing deformation. (All scales represent 1 mm.)



1: Concretion with bryozoan-encrusted gastropod, *Neptunea sp. cf. N. antiqua* (Linn.), from ground moraine near Ithaca, N. Y., x0.9. (C.U. No. 40606). 2: Enlargement of surface of bryozoan, x14.5 3: *N. antiqua* (Linn.), Recent, North Sea, xo.51. (Newcomb Coll., C. U. No. 19265). (Partial cost of plate defrayed by the Gurley Fund for Paleontology, Cornell University.)

partment of Geology. Attention is called to it here in hope that more may be found and their ultimate source determined.

The concretion (Pl. 4, fig. 1) was found loose on the surface on the west side of the Six Mile Creek valley near the Coddington Road one mile south of the Ithaca city line, at an elevation of about 900 feet. It is incomplete, only the larger half remaining, pyriform according to the shape of the enclosed fossil, with a broad, shallow, flat-bottomed depression on one side. Length: 8.6 cm., maximum diameter: 6.2 cm. It is non-stratified, non-septarian, composed of gray silt containing many minute flecks of black plant fragments and light-colored chips of shells. In the center is a gastropod, here tentatively identified as *Neptunea sp. cf. N. antiqua* (Linn.), a northern Pliocene-Recent species, 5.2 cm. in height and 2.3 cm. across the body whorl, imbedded so that the aperture is concealed in matrix. The two layers of the shell on the body whorl have a thickness of 2 mm. A longitudinal half of the spire broke away with the missing half of the concretion, exposing the interior which is partly filled with coarse calcite crystals. The entire exterior is covered by an encrusting bryozoan from 1 to 2 mm. thick, worn but effectively concealing the external surface of the shell (fig. 2). The natural section of the shell faintly indicates the presence of fine revolving ridges on the outer surface like those of *Neptunea antiqua* (fig. 3).

The provenance of this concretion and its bryozoan-encrusted mollusk is naturally the main problem. There is no marine Pleistocene in central New York; the nearest marine deposits are in the St. Lawrence and Champlain valleys some 200 miles to the northeast. Since it was found in ground moraine of the last (Wisconsin) glaciation, it can only have been derived from some pre-Wisconsin marine interglacial deposit to the north. The interglacial marine beds were analyzed a few years ago by Coleman (1941, Chapt. 5), and their faunas were described many years ago by Dawson (1871, 1893, *int. al.)* who cautiously called them "post-Pliocene." Dawson's accounts are still the most complete, but he mentions only one occurrence of fossiliferous concretions anywhere in the possible source area: the famous site on Green's Creek near Ottawa (1894, p.203). The concretions on Green's Creek, however, consist of fine gray clay with calcareous cement, quite different from the cemented silt of the Ithaca specimen. Nor has *Neptunea* been recorded from this locality or elsewhere

this far west. Dawson reported *N. despectus* (Linn.) from a number of interglacial deposits from Quebec eastward into New Brunswick and Labrador, noting that the specimens graded from *N. tornata* to *N. antiqua,* and that the three forms might well represent a single variable species.

Most of the interglacial marine beds of eastern Canada must have been swept away by the Wisconsin ice, and quite possibly we are here concerned with a relic from some vanished deposit.

References

Coleman, A. P., 1941. The last million years. Univ. Toronto Press.

Dawson, J. W., 1871. The post-Pliocene geology of Canada. Canadian Naturalist, N.S., *6:* p.19-42; 166-187; 241-259; 369-416.

—— 1894. The Canadian ice-age. Montreal, New York, & London.

THE TYPE OF POLYPLEX PERRY

By JOSHUA L. BAILY, JR.

The generic name *Polyplex* was originated by Perry (1810) but was not properly characterized until the following year, when he figured 5 species assigned to it in his Conchology. These illustrations are so crudely executed that, in the opinion of the present writer, they cannot be recognized. However, in commenting upon them, Perry declared that *Polyplex purpurascens* is the species from which the Tyrians obtained their famous purple dye. Although several species served this purpose in various parts of the Mediterranean basin, the Tyrians seem to have depended exclusively upon *Murex trunculus* Linnaeus (1758, p. 747) which seems to indicate that this species should be considered the type of *Polyplex* by virtual monotypy.

However, in the course of a recent investigation of a nomenclatorial nature, two other identifications of species of *Polyplex* have come to light, which if accepted will necessarily require that a subsequent writer select the type from among these three, since Perry himself did not designate any type. Therefore, any subsequent writer, who desires to fix the type of this genus, should consider carefully the qualifications of each of these, and determine which one would cause the least disturbance of established nomenclature if designated as type.

Murex trunculus is the type by original designation of *Truncularia* Monterosato (1917) but this name is preoccupied by

Truncularia Wiegmann (1832), a millepore. Consequently the name *Truncülariopsis* Cossmann (1921) was proposed to replace it. If *Polyplex purpurascens* be selected as generitype, the name *Polyplex* would replace *Truncülariopsis.*

The second of Perry's species to be identified was *Polyplex gracilis,* which Carpenter (1864, p. 520) declared to be identical with *Murex multicostatus* Eschscholtz (1829). But Carpenter (loc. cit., p. 663) also identified *Trophon gunneri* Lovén (1846) with *Murex multicostatus* so that his identification is not very helpful. The species named by Eschscholtz and by Lovén, although closely related, are generally recognized as distinct.

The next identification of *Polyplex gracilis* was made by Gabb (1869) whose use of it as a synonym of *Fusus multicostatus* is unequivocal, *Trophon gunneri* not being mentioned.

Both of these identifications were rejected by Dall (1902) who claimed that Carpenter and Gabb had misunderstood *Trophon gunneri* and *Fusus multicostatus* respectively.

Arnold (1903) assigned both species synonymized by Gabb to *Boreotrophon* Fischer (1884). He cited the same locality for each (Alaska to northern California) and decided that the species commonly represented in collections is actually *Boreotrophon gracilis* although generally but incorrectly it is labeled *Boreotrophon multicostatus.* He published figures of both species on the same plate. They appear to be quite unlike each other. *Boreotrophon gracilis* has tabulate whorls and peaked varices, while in *Boreotrophon multicostatus* both these features are rounded.

Presumably Dall approved the distinction drawn by Arnold at the time, since he had examined Arnold's material, but a few years later he seems to have changed his mind, for Dall (1921) reported *Boreotrophon multicostatus* from the Pacific American coast, but ignored *Boreotrophon gracilis* completely. If he had considered the two species identical he would have used the older name. He may have considered *Boreotrophon gracilis* as not recognizable, or he may have thought that it did not occur living within the limits covered by this reference. But the figure which he published is not the species called *Boreotrophon multicostatus* by Arnold but represents what Arnold considered to be *Boreotrophon gracilis.*

Finally, MacGinitie (1959) united *Boreotrophon multicostatus*

and *Boreotrophon gunneri* but made no mention of *Boreotrophon gracilis.*

Since all these species belong to *Boreotrophon,* that name will be replaced by *Polyplex* if *P. gracilis* be made the type. But *Borotrophon* is now generally considered to be a subgenus under *Trophonopsis* Bucquoy, Dautzenberg, and Dollfus (1882) and since *Polyplex* is older than *Trophonopsis* it will not only displace *Boreotrophon* as a subgenus but also *Trophonopsis* as a genus.

The third of Perry's species to be identified is *Polyplex rugosa,* which Dall (1915) placed in the synonymy of *Nucella lamellosa* (Gmelin, 1792). The genus *Nucella* was established by Röding in Bolten (1798), a work in which no types were selected and no authorities cited. The type of *Nucella* was inadvertently designated by Iredale (1915) who mistakenly thought that Dall (1909) had selected *Buccinum lapillus* Linnaeus (1758, p. 739). But Dall cited this species only as an example, not as a type; it is not on the list cited by Röding. Röding's *Nucella lapillus* is a different species altogether, but Iredale did not know this, and designated Röding's species. This readily can be recognized by the references given by Röding to Gmelin (1792, p. 3486) and to Chemnitz (1777). The first of these refers to the second, which is a plate readily recognizable as representing *Buccinum smargdula* Linnaeus (1758, p. 739) which includes in its synonymy *Buccinum rusticum* Gmelin, which is the other reference cited by Röding. This species was later made the type of *Latirolagena* by Harris (1897) which name must now be superseded by *Nucella.*

According to Dall (1915) *Nucella lamellosa* Gmelin is identical with *Nucella crispata* Röding in Bolten (1798) which last named species was selected by Swainson (1840) as type by original designation of his genus *Polytropa. Baccinum lapillus* Linnaeus is congeneric. If *Polyplex rugosa* be made the type of *Polyplex,* that name will replace *Polytropa* Swainson.

The above shows that any legal designation of type for *Polyplex* will cause that name to displace one of the names: *Trunculariopsis, Boreotrophon, Trophonopsis,* or *Polytropa.* Of these, the last three have been in general use ever since they first were published and are understood universally; on the other hand *Trunculariopsis* has been used so little that Grant and Gale

(1931) had never heard of it, and, when they learned that *Truncularia* Monterosato had to be abandoned, they proposed the new name *Murithais* to replace it. Therefore established usage clearly will be least disturbed if *Polyplex purpurascens* = *Murex trunculus* be made the type of *Polyplex*. And, there are other reasons for believing that it would be preferable to either of the other two species. It is the first species on Perry's list; it is the only species whose recognition is beyond any possibility of reasonable doubt; and it is the only one that has never at any time been confused with another species. For these reasons, I have no hesitation in selecting as the type of *Polyplex* the species *Polyplex purpurascens* Perry = *Murex trunculus* Linnaeus, and so I hereby make this designation.

References

Arnold. Mem. Calif. Acad. Sci. *3*:250-1, pl. 6, f. 8,9. 1903.
Bucquoy, Dautzenberg, and Dollfus. Mar. Moll, Roussillon, v. 1:140. 1882.
Carpenter. Suppl. Rept. Brit. Ass'n for 1863: 520, 663. 1864.
Cossmann. Revue. Crit. Paleozoöl. *25*:79. 1921.
Dall. Proc. U.S.N.M. *24*:543. 1902.
—— Prof, Paper U. S. Geol. Surv., no. 59, pp. 48, 50. 1909.
—— Proc. U.S.N.M. for 1916, *49*:565. 1915.
—— Bull. U.S.N.M. *112:* 110, pl. 13, f. 1. 1921.
Eschscholtz. Zoöl. Atlas, v. 2, p. 11. 1829.
Fischer. Man. de Conchyl., pt.2, p. 640. 1884.
Gabb. Geol. Surv. California, Paleont. *2*:70. 1869.
Gmelin. Syst. Nat., 13th edn., pp. 3486, 3498. #792.
Grant and Gale. Mem. San Diego Soc. Nat. Hist. *1*:729. 1931.
Harris. Catal. Tert. Moll. Brit. Mus., v.l,p. 150. 1897.
Iredale. Trans. and Proc. New Zealand Inst., for 1914, *47*:472-6. 1915.
Linnaeus. Syst. Nat., 10th edn., pp. 739, 747. 1758.
Lovén. Ofvers. Kongl. Vetensk. Akad. Förh. *3*(5):194. 1846.
MacGinitie. Proc. U.S.N.M. *109*:98, 1959.
Martini and Chemnitz. Neues Syst. Conchyl, Cab., v. 3,p. 120, f. 1104-5. 1777.
Monterosato. Bull. Soc. Zoöl. Ital., ser. 3, *4:* 20. 1917.
Perry. Arcana, 1810. pls. 23. 35. Neither the pages nor the plates in this strange work are numbered, but the name *Polyplex* is mentioned in the text corresponding to the 23rd and 35th plates. The numbers of the plates must be determined by counting them.
—— Conchology, pl. 9. 1811.
Röding in Bolten. Museum Boltenianum, v. 2, p. 140. 1798.
Swainson. Treat, Malac., pp. 80, 81, 395. 1840.
Wiegmann. Handb. der Zoöl., p. 596. 1832.

A RAPID METHOD FOR PREPARING MOUNTS OF SNAIL GENITALIA*

By EDWARD H. MICHELSON
Department of Tropical Public Health, Harvard School of Public Health, Harvard University, Boston 15

The comparative anatomy of the genitalia is of importance in the taxonomic discrimination of species of snails, especially Pulmonata. Permanent preparations of dissected genitalia form a synoptic reference collection, invaluable for both teaching and research. Gregg (Ann. Report Amer. Malac. Union, p. 39, 1958) described a technique for the preparation of stained *toto* mounts, which, although excellent, is time consuming and requires a high degree of technical skill.

I have found that the use of CMC-10, a proprietary non-resinous mounting medium (obtained from the General Biological Supply House, Chicago) provides a rapid method for the preparation of whole mounts. Its major advantages are: 1) Tissues may be mounted directly in it from water or low grades of alcohol (*e.g.*, 50-70%). 2) Mounts are cleared in approximately four hours, yet details of structure and color are preserved. 3) A minimum degree of technical skill is required for the preparation of mounts. 4) CMC-10 is not expensive when compared with the cost of the various chemicals needed for longer methods.

Permanent mounts of snail genitalia are prepared in the following manner. Snails killed by immersion in boiling water or 70% alcohol are dissected in 50-70% alcohol. Isolated genitalia are placed in distilled water for ten minutes, then oriented in a drop of CMC-10 on a glass slide. Sufficient CMC-10 is added to cover the specimen and a glass coverslip is applied. The slide is dried for 24 hours at room temperature or for 3-4 hours at 37° C. After drying, it is advisable to ring the coverslip with clear nail polish or commercial ringing lacquer. The thickness of some specimens may necessitate the addition of supports for the coverslip or the use of depression slides.

Twelve-month-old preparations have shown no deterioration and have proved to be excellent as subject material for microscopic examination, camera lucida drawings, and photmicrographs. So far as I am aware, the sole disadvantage of the method

* This study was supported (in part) from a research grant (E-513-C) from the National Institute of Allergy and Infectious Diseases, National Institutes of Health, Public Health Service.

is that specimens cannot be stained. However, this drawback is not serious and is counterbalanced by the fact that artifacts resulting from routine dehydration techniques are reduced to a minimum.

NOTES AND NEWS

Dates of the Nautilus.—Vol. 73, no. 1, pp. 1-38, pls. 1-6, was mailed July 20, 1959. No. 2, pp. 39-78, Oct. 3, 1959. No. 3, pp. 79-118, pls. 7-11, Jan. 25, 1960. No. 4, pp. 119-160, title pages and indexes, pls. 12 & 13, April 4, 1960.—H. B. B.

Dr. Paul Bartsch, Curator Emeritus of the Division of Mollusks of the United States National Museum, died on April 24, 1960, at Lorton, Virginia, at the age of 89. An obituary by Dr. Harald A. Rehder will appear in a future number of the Nautilus.—R. T. A.

Norman T. Mattox, Professor of Biology at the University of Southern California, died on February 1, 1960 at the age of 49. A full obituary is in the Bulletin of the Southern California Academy of Sciences, vol. 55, pt. 1, pp. 53-55 with portrait—R.T.A.

Pomatiopsis lapidaria on the southern Atlantic coastal plain, with remarks on the status of *P. praelonga* and *P. hinkleyi*.—The author recently collected *Pomatiopsis lapidaria* (Say) at several localities on the southern Coastal Plain, a region from which it was previously unknown. In this region, it was found in swamps, but only in swamps with uneven ground in which there were numerous small hummocks of dry land to which they could retreat during the wet season. It was not found in swamps which were completely flooded during the spring.

Localities: *North Carolina:* Craven Co.: near Little Creek, 1 mile north of Askin; near Batchelder Creek, 2.4 miles east of Tuscarora. Beauford Co.: 2.4 miles east of Washington. Chowan Co.: 1.4 miles southeast of Edenton. Brunswick Co.: near Piney Grove Creek, 2.4 miles southwest of Bolivia. *South Carolina:* Bamberg Co.: near Little Salkehatchie River, 4.2 miles north of Eherhardt. *Georgia:* Richmond Co.: near McBean Creek, 5 miles west of McBean. Chatham Co.: near Middle River, Onslow Island.

Pomatiopsis praelonga Brooks & MacMillan, (Naut. *53*:96,

1940) was described from specimens collected on the hillside along Elk River, 1.5 miles south of Clay, Clay Co., West Virginia. This is undoubtedly a very dry habitat form of *P. lapidaria.* Similar shells have been found on dry hillsides at a number of localities, but notably on the Cumberland River bluff opposite Carthage, Tennessee. Here the hillside has a sparse growth of timber and is so steep that most of the soil has washed away and there is very little leaf cover, but *P. lapidaria* was abundant. They were as slender as topotypes of *P. praelonga.*

Pomatiopsis hinkleyi Pilsbry, (Naut. *10*:37, 1896) was described from specimens collected at Black Falls, above Florence, Alabama. Efforts by the author to find this locality were unsuccessful. It probably was destroyed by the construction of the Wilson Dam. *P. hinkleyi* differs from *P. lapidaria* in having a more obese and thinner shell. Similar shells were collected at a dripping spring, 3 miles north of Ashland City, Cheatyam Co., Tennessee, and from a swamp in Bamberg Co., South Carolina (see above). This appears to be a wet habitat form of *P. lapidaria,* possibly living in the spray of a falls.

Pomatiopsis lapidaria varies with ecological conditions. Slender thick shells occur in dry habitats, and obese thinner shells in wet ones. This is especially noticeable in the south. *P. praelonga* and *P. hinkleyi* appear to be but extremes of this variation.

— Leslie Hubricht.

Trichia hispida (L.) in New York.—This species was found abundant along the roadside and in a gravel quarry 1.4 miles south of Sharon, Schoharie Co., New York. Unlike other colonies reported from North America, most of the shells at this locality are hirsute.—Leslie Hubricht.

Hydrobiidae or Truncatellidae?—In opinion 475, 1957, Bull. Zool. Nom. *16*:307-330, Bithyniidae Gray, 1857, was put on the approved list, "for use by specialists who on taxonomic grounds consider that the genus *Bithynia* Leach is not referable to any nominal family-group taxon having an older name" (p. 325). Please remember that *Bithynia* (1818), *Bithinia* Gray (1824; nude in 1821) and *Bythinia* Macgillivray (1843) are different spellings for one genus. The following outlines the familial names which are prior (in *italics*):

Truncatellidae Gray, 1840, Syn. Brit. Mus., ed. 42:119. (Cf. opinion 344).

Bythiniae, Lithoglyphi, Hydrobiae,[1] Troschel, before Sept., 1857, Gebiss der Schnecken *1*(2):101, 104, 106, respectively. Reviewed by L. Pfeiffer, Sept., 1857, Malacoz. Blätter *4*:223-224.

Bithiniadae Gray, after Sept., 1857 (manuscript date of "Preface," p. xi), Turton's "Manual," new ed.:16, 24. (Gray placed *Hydrobia* in Littorinidae, p. 24.)

Hydrobiinae Stimpson, 1865, Smithson, Misc. Coll. *201*:4; included *Lithoglyphus,* which subordinated Lithoglyphi.

Hydrobiidae Fischer, 1885, Man. Conchyl.:723; included (p. 724) Bithiniinae and Lithoglyphinae. Thiele, 1929, Handb. syst. Weichtierk.:136; included Lithoglypheae, Truncatellinae and Bithyniinae (pp. 145, 149, 153).

Obviously, if Thiele's (1929) classification be followed, Truncatellidae, 1840, is the prior name for his family. However, if *Truncatella* be excluded, Hydrobiidae, 1857, would become the legal name of the restricted family, unless a "first reviser" subordinated it to Bithyniidae before Fischer, 1885, reversed that action. Although perhaps without nomenclatural effect on this question, Tryon, 1866, Amer. J. Conch. *2*:155-156, included Bythiniinae, Hydrobiinae and Lithoglyphinae as subfamilies in his Amnicolidae, 1862, Proc. Acad. Nat. Sci. Philadelphia *14*:452.

Of course, Troschel must have initiated Hydrobiidae before Pfeiffer's (Sept., 1857) review, and Gray's Bithiniadae must have been published (probably some months) after his identical, but manuscript date. Incidentally, according to the "rules," Troschel also became the author of at least Lithoglyphinae; and he used a rejected spelling of Bithyniinae before Gray did.

— H. Burrington Baker.

Planorbina (1843) vs. *Australorbis* (1934) vs. *Biomphalaria* (1910) vs. *Taphius* (1854).—Bengt Hubendick, 1958, Rev. Brasil. Biol. *18*(1): 37-40, has proposed that the ICZN. use its plenary powers to validate *Biomphalaria* Preston. This is opposed for 2 reasons:

(1) *Australorbis* is in more general use than *Biomphalaria.* About a year ago, this was tested by counts of the citations of the 2 names in the Zoölogical Record since 1934. *Australorbis* was mentioned about 1½ times as often as was *Biomphalaria.* This is not surprising, because the former was the first of the considered names which was described accurately, and Dr. Pilsbry's

---

1 ". . . to review the genera in small groups, without wishing to claim for them the value of families." (Translation, p. 95).

personal prestige was very great. The systematic position of *Biomphalaria* was not proved until about a decade later, and that of *Taphius* in 1957.

(2) The prior name for the composite genus is *Planorbina*. The history of this name follows:

Planorbina Haldeman, 1843, Monogr. Physades: 14, as a "subgeneric section" of *Planorbis,* with a vague, 4 word "description," and without mention of species.

Planorbina "Hald." Dall, 1905, Alaska *13*:84, type by subsequent designation, and first and only species, *Planorbis olivaceus* "Spix" (Wagner, 1827; = *Planorbis guadaloupensis* Sowerby, 1822, Genera shells: fig. 2; also included by Dall on p. 81), used as a "section" of *Planorbis.* On this basis, *Planorbina* adopted by the following:

1918, Walker, B., Univ. Mich. Muz. Zool. Mis. Publ. *6*:11, 99.
1921, Germain, L., Rev. Indian Mus. *21*:6, 41.
1923, Wenz, W., Fossil. Catalog.: 1482 (used as genus).
1928, Hoffmann, H. Klass. u. Ordnung. Tier-reichs *3*(2:3):1249.
1930, Occ. Papers Univ. Mich. Mus. Zool. *210*:43-46.
1931, Thiele, J., Handbuch der system. Weichtierkunde:480.

Planorbina "Dall" Pilsbry, 1934, Proc. Acad. Nat. Sci. Philadelphia *86*:55, with *Australorbis,* type by original designation "*Planorbis guadaloupensis* Sowerby (= *glabratus* Say)," proposed to replace it, on grounds that *P. olivaceus* did not fit Haldeman's words: "Whorls numerous, nearly equal," which would cover most planorbids.

On p. 43, Pilsbry also replaced *P. guadaloupensis* Sowerby, by a century old "nomen dubium," *Planorbis glabratus* Say, 1818, Journ. Acad. Nat. Sci. Philadelphia *1*:280, from "South Carolina," where the species does not and probably never did live. During lengthy discussions, before and after his publication, Dr. Pilsbry and I agreed on only 3 points:

(1) Despite opinion 46, "genera" without species should have been considered "nomina dubia," which would have rendered Dall's usage a homonym. (This was the actual reason why Pilsbry rejected *Planorbina.)*

(2) Haldeman (1843) probably was more familiar with the European *Anisus* than he was with the tropical American "*Australorbis.*"

(3) Say (1818) probably did base his *Planorbis glabratus* on some "*Australorbis,*" and *Planorbina guadaloupensis* (Sowerby) is the most widely distributed, and best-known species. However, it was identified by the next (after Say) generation, who might (?) have seen the type specimen (now lost), with totally different

species. Incidentally, Fischer & Crosse, 1880, Moll. Mex., etc. *2*:67, did not attempt any "identification of Say's type" (Contrast Walker, 1918, p. 99) — H. Burrington Baker.

Gyraulus arizonensis in Texas.—At my request, Mr. Robert Downing, Oklahoma State University Wildlife Unit, made a collection of terrestrial and freshwater mollusks from the Rob and Bessie Welder Wildlife Refuge of Texas. This refuge, under the able direction of Dr. Clarence Cottam, is located in the coastal plains near Sinton, San Patricio County, Texas (c.28° N. Lat.). Its vegetation is intermediate between that of the Texan and Tamaulipan biotic provinces and the rainfall is only slightly above physiological requirements. The north border of the station is formed by the Arkansas River and the eastern line is only about five miles from the Copano Bay of the Gulf of Mexico. A part of the refuge, locally termed the "mare trap," is located in the eastern quadrant of the property. The waters of this area are subjected to periodic increased salinity and the shores foster several brackish-water plant species such as *Spartina*. A part of Mr. Downing's collections were taken from the "mare trap" and one of these forms the basis for this report.

While sorting through drift debris from the last-named region I found a single immature specimen of an unusual planorbid snail. This form, consisting of about 2½ turns, was covered with conspicuous, spiral striae. Additional searching uncovered 90 more specimens, ranging in size from 1.1 mm. to 3.2 mm. in diameter and of 2 to 3-2/3 whorls, all sculptured as the first one. Comparing these specimens with some virtual topotypes of *Gyraulus arizonensis* (Pilsbry and Ferriss) taken from the banks of the San Pedro River, Arizona, I was unable to distinguish between the two lots, and therefore concluded that the Texas shells are *G. arizonensis*. This species is probably much more widely distributed than was originally supposed.

Several other interesting molluscan species were found in the same collection. The following is a list of these species: approximately 1000 *Drepanotrema cultratum labrosum* Pilsbry, 1 *Pyrgophorous spinosus* (Call and Pilsbry), approximately 500 *Planorbina (Obstructio) obstructa* (Morelet), 500 *Planorbina (Tropicorbis) orbiculus*, 1 immature *Cincinnatia peracuta* (Pilsbry and Walker), 1 *Texadina sphinctostoma* Abbott and Ladd and 9

Mytiliopsis leucophaeta (Conrad).

With the exception of 12 specimens of *G. arizonensis,* which were deposited in the U. S. National Museum (#622469), all specimens were retained by the author. These records will become incorporated into a larger report of the Mollusca of the Welder Wildlife Refuge. I wish to thank Dr. Morrison for his kind assistance, Mr. Downing for making the collections and Dr. H. B. Baker for clarifying some nomenclatural points.

— Branley A. Branson[1]

Purpura, Nucella, or Thais?: The problem continues.—On March 3, 1922, William J. Clench, now Curator of Mollusks at the Museum of Comparative Zoölogy, but then a young student of shells, wrote to E. S. Morse, Director of the Peabody Museum at Salem as follows, "Seven years ago, when I first started to collect shells, I collected *Purpura lapillus*—four years ago I collected *Nucella lapillus*—now I collect *Thais lapillus ! ! !* Seven years and three different generic names."[1]

In nearly 40 years the problem has still not been settled. In the 1957 Index of *Biological Abstracts,* references are found to all 3 genera for the species. In the last July *Nautilus,* the names *Thais lapillus* and *Nucella lapillus* are found 4 pages apart. (Naut. *73:* 12 & 16. 1959). In 1947 Dr. Clench established *Thais* as the proper generic name for this species *(Johnsonia 2*(23):86-89. 1947). It is unfortunate that workers in zoology do not make greater effort toward uniformity in nomenclature and follow the recommendations of authoritative monographs.—Ralph W. Dexter, Department of Biology, Kent State University, Kent, Ohio.

This is actually an example of the confusion dug up with Röding's names (both *Nucella* and *Thais*). Thiele's "Handbuch" (p. 298) was often "authoritative."—H. B. B.

Fred L. Button Collection.—The shell collection of the late Fred L. Button of Oakland, California, who died in 1927 (see obituary in Nautilus, 42: 33-34), has been purchased by Chicago Natural History Museum. Besides containing about 3500 sets of

---

[1] Contribution #300 from the Department of Zoology and from the Research Foundation, Oklahoma State University.

---

[1] Letter on file at the Peabody Museum, Salem, Massachusetts, and quoted with permission from Ernest S. Dodge, Director.

west American shells, he had representatives of about 5000 species of marine shells, and 4000 species of land and fresh-water shells. The total collection contains about 70,000 specimens in 15,000 sets.

Included are Red Sea shells collected by Förskal and Jickeli, holotypes of several species of *Trivia,* paratypes of many South Australian, New Caledonian, and European marine and land snails obtained from Gatliff, Verco, Hedley, and Dautzenberg, and several hundred sets of Hawaiian land shells from D. D. Baldwin—to name but a few items.

The cowrie shells were Mr. Button's favorites. Of the 165 species recognized by the Schilders, he had 143, plus one of the five original specimens of *Cypraea pacifica* Ostergaard (= *ostergaardi* Dall). With additions from other collections, Chicago Natural History Museum now has 150 species of cowries represented.

— ALAN SOLEM.

CHARLES G. NELSON COLLECTION.—The shell collection of the late C. G. Nelson of Grand Rapids, Michigan was obtained by Chicago Natural History Museum in 1958. The unpacking of this vast collection has just been completed. Approximately 300,000 specimens in 30,000 sets were recent shells, together with 83,000 fossil invertebrates, 4,000 mineral specimens, 100 turtle shells, and much other miscellany. Mr. Nelson had give 66,000 pairs of fresh-water clams to Michigan State University before his death in 1957.

The basis of the collection was formed by Frederick Stearns (see Pilsbry's "Catalogue of the marine mollusks of Japan" published by Stearns in 1895), with the addition of the R. J. Kirtland and H. E. Sargent collections, together with the results of a lifetime series of collections throughout North America. Almost every well-known marine and land collecting area was visited by "C. G." and thoroughly worked for shells.

Unlike many amateurs, he was not contented with one of a kind, but collected, and kept, long series of shells. One feels a real sense of awe when viewing the long sets of Japanese shells from Stearn's collection, or the fantastic series of North American shells collected by Nelson. Duplicates of these series will eventually be available for distribution to other institutions or for exchange to amateurs. — ALAN SOLEM.

TO CONTRIBUTORS.—Despite the addition of 4 pages to each

number, enough MSS. are on file to fill the October and half the January, 1961, numbers. From previous experiences, this condition may be only temporary. MSS. will be published in order of their dates of receipt, except precedence will be given to new species. Because of lack of space, the following reviews, which already were written and would have required 4½ pages, have been cut to references only. Suggestions for the amelioration of this would be welcome, but the NAUTILUS, which is published at cost of printing, could not enlarge its size much more without corresponding increases in subscription prices. Of course, some savings might be made if only MSS. by subscribers were accepted.

— EDITORS.

PUBLICATIONS RECEIVED, 1958

Pages in *italics* include new taxons

Hubricht, Leslie. New species of land snails from the eastern United States. Trans. Ky. Acad. Sci. *19:70-76*.

Mason, James. The breeding of the scallop, *Pecten maximus* (L.) in Manx waters. J. Mar. Biol. Ass. U. K. *37:*653-671, 5 figs. A possible lunar periodicity in the breeding of the scallop, *Pecten maximus* (L.). Ann. Mag. Nat. Hist. (13) *1:*601-602.

Thompson, Thomas E. The natural history, embryology, larval biology and post-larval development of *Adalaria proxima* (Alder & Hancock). Phil. Trans. Roy. Soc. London, Biol. Sci. *242:*1-58, 49 figs. The influence of temperature on spawning in *Adalaria proxima* (A.&H.) Oikos *9:*246-252, 1 fig.

1959

Arias C., Sergio. *Arion subfuscus* (Draparnaud). Venezuela. Mem. Soc. Cien. Nat. la Salle *19:*23-36, 6 figs.

Basch, Paul F. Land Mollusca of the Tikal National Park in Guatemala. Occ. Papers Mus. Zool. Univ. Mich., no. *612:*15 pp., 1959.

Branson, Branley A. Oklahoma gastropods: etc. Proc. Okla. Acad. Sci. *37:*30-32. Notes on Okla. snails, with new records. Notes on Okla. slugs, etc. S. W. Naturalist *3:*224-226. *4:*143-147.

Dodge, Henry. Evidential factors in the identification of the Linnaean molluscs. J. Linn. Soc. London, Zool. *44:*170.179.

Emerson, William E. & Emery P. Chace. Pleistocene mollusks from Tecolote Creek, San Diego, California. Trans. San Diego Soc. Nat. Hist. *12:*335-346, 3 figs.

Hubendick, Bengt & Pavle Radoman. Studies on the *Gyraulus* species of Lake Ochrid Morphology. Arkiv för Zool. *12:223-243,* 42 figs.

Johnson, Richard I. The types of Corbiculidae and Sphaeriidae

in the Museum of Comparative Zoology, and a bio-bibliographic sketch of Temple Prime, etc. Bull. Mus. Comp. Zool. Harvard *120:431-479,* 8 pls.

MacGinitie, Nettie. Marine Mollusca of Point Barrow, Alaska. Proc. U. S. Nat. Mus. *109*(3412)*:59-208,* pls. 1-27.

Ortiz de Zarate Lopez, Adolfo & Antonio Ortiz de Zarate Rocandio. Descripcion de los moluscos terrestres de la Isla de Fernando Poo (Familia Achatinidae). *128 pp.,* 8 pls. & 82 figs. Inst. Estud. Africa., Madrid.

Paraense, W. Lobato. One-sided reproductive isolation between geographically remote populations of a planorbid snail. Amer. Nat. *93*:93-101, 1 fig.

Riedel, Adolf. *Oxychilus (Oxychilus) disciformis* sp. n. aus dem Iran und Bemerkungen über *Oxychilus ? gorktschaanus* (Mousson). Die von Dr. K. Lindberg in Griechenland gesammelten Zonitidae. Materialien zur Kenntnis de paläarktischen Zonitidae, 3-4. Ueber drei Zonitiden—Arten aus der Höhlen der Turkei. Ann. Zool. Polska Akad. Nauk *18:71-78, 89-117,* 119-126, 141-160, 1 pl., 44 figs.

Robertson, Robert. The subgenus *Halopsephus* Rehder, with notes on the western Atlantic species of *Turbo* and the subfamily Bothropomatinae Thiele. J. Washington Acad. Sci. *47:316-319,* 3 figs.

Solem, Alan. Notes on Mexican mollusks, 2. Occ. Papers Mus. Zool. Univ. Mich. *611:15 pp.,* 2 pls.

—— Systematics and zoogeography of the land and fresh-water Mollusca of the New Hebrides. Fieldiana: Zool. *43*(1&2)*:1-359,* 33 pls., 38 figs.

Thompson, Fred G. Two new pleurocerid snails from eastern Mexico. A new helicid snail from Mexico. Occ. Papers Mus. Zool. Univ. Mich. *600:9 pp.,* 1 pl. & 2 figs. *610:8 pp.,* 1 pl. & 1 fig.

Voss, Nancy A. studies on the pulmonate gastropod *Siphonaria pectinata* (Linnaeus) from the southeast coast of Florida. Bull. Marine Sci. of Gulf & Caribbean *9*:84-99, 5 figs.

THE NAUTILUS

Vol. 74 October, 1960 No. 2

MOLLUSKS AND BRACHIOPODS FROM AFOGNAK AND SITKALIDAK ISLANDS, KODIAK GROUP, ALASKA

By WALTER JACOB EYERDAM

Since 1917, I have worked 24 summers in various parts of Alaska in the whaling and herring fisheries. Until 1946, I always had worked as cooper, but then the trade became obsolete in Alaska. In spite of a usual average of 350 to 400 hours work per month, with few Sundays or holidays, I made large biological collections. As one of the principal collaborators, who contributed by collection of plants, for Prof. Eric Hulton's great work (16 vols. on the floras of Kamchatka, Aleutian Is., and Alaska and Yukon Territory), I collected over 3500 lots of higher plants, and several thousand lots of lichens and bryophytes. Prof Hulton is Director of the Riksmuseum of Sweden, in Stockholm, and is the foremost authority on circumboreal plants.

Intensive collections of mollusks also were made in nearly every place where I worked. My first printed report was on the "Marine shells of Drier Bay, Knight Island, Prince William Sound, Alaska" Naut. *38* (1) :22-28, 1924. Although I have series of most of the shells collected by me in Alaska, and made notable collections in many places, I have neglected publication of most of them. The main reason for this is because I loaned most of my collection of *Lora-Bela* to Dr. Bartsch several years before the last world war, to be used in collaboration with the Russian Academy of Sciences in working up deep sea collections from the Arctic Ocean and the western Bering Sea. So far I have not succeeded in having them returned to me, and consequently have not learned the changes in names. Bartsch originally had identified them for me.

In the present report, I have selected Afognak and Sitkalidak Islands (about 800 and 200 square miles, respectively) where I spent four seasons. These two islands are near opposite ends of Kodiak (3465 square miles), our largest island, and these shells illustrate quite well a cross-section of most of those to be found

in the Kodiak Island group and Shelikof Strait. Although most of the genera in this list are also in Prince William Sound, many species are not the same in the two areas.

Having done a lot of shell collecting, in many parts of the Alaskan coast, I sometimes have wondered which areas might be the richest in diversified marine life. With deep tides running out on many beaches, which teem with life, in isolated bays in southeast Alaska, the Kodiak Islands and Prince William Sound, I believe the richest place of all probably would be around Orca on Hinchinbrook Island in Prince William Sound, although I never have collected there. All my dredging was done from small rowboats, usually after long days of hard work, and results were often poor and discouraging, when one considers the great amount of muscle work it required.

With even the simplest modern gear for dredging with slow power boat, excellent results should be obtained. Nearly all my hand dredging in Izhut Bay in 1922 was done alongside of our old schooner, the Henry Wilson, when she lay at anchor for four months. The same method was employed at Red Fox Bay, on Shuyak Strait, while aboard the giant, five masted (180 feet high; 2200 tons) by the wind schooner Bianca, which was wrecked on the Clallam Rocks in Strait of Fuca during a great snowstorm on the homeward voyage. I seldom dredged in over 10 fathoms, but often in bad weather.

Some of the best habitats for collecting minute shells in Alaska are among a profusion of nullipores, or calcareous algae. In Drier Bay, Prince William Sound, the best habitat was usually on the leaves or at the roots of *Zostera marina,* or eel-grass, which must be uprooted, washed and sieved in a tub. Since the great epidemic, which destroyed such a large percentage of the eel-grass beds in the northern hemisphere, much of the area has failed as yet to make a good comeback, so probably many small species of shells and other organisms have become either extremely rare or extinct. Nobody seems to know what caused the disease.

In order to avoid repetition of locality names for each species of mollusk on the list, the following four localities are designated by numbers (in parentheses):

1: Izhut Bay, Afognak Island; May to November, 1922.
2: Red Fox Bay, Shuyak Strait, Afognak Island; July to October, 1924.

3: Port Hobron, Sitkalidak Island, at whaling station; July 6 to September, 1931.

4: Raspberry Strait, Afognak Island; 1939, 1945 and 1946.

Extensions of range of shells in this list are extensions beyond those in Dall's Bull. 112 of the U. S. National Museum. Most of these same range extensions also may be located under my name in the "Author index," Index to the Nautilus, vols. 35-60, or in John Q. Burch's (1959) index. See especially:

Extended ranges of seventy five species of north Pacific shells collected by Walter J. Eyerdam and Ingvard Norberg. Naut. *51*:100-104, & 122-126, 1938.

Extended ranges of four Alaskan marine shells. Naut. *57*:142, 1944.

PELECYPODA

Nucula tenuis Montagu, 10 fms., mud, not uncommon (1, 3, 4).
N. tenuis expansa Reeve, 10-15 fms., mud, not common (1).
N. (Acila) castrensis Hinds, mud, not common (1).
Leda minuta (Fabricius), mud, fairly common (1, 2, 3).
Yoldia scissurata (Dall), 20 fms., fine mud (1).
Y. ensifera (Dall), 20 fms., fine mud, a few (1).
Y. limatula (Say), mud, 10 fms., several (4).
Pecten alaskensis Dall, sandy bottom, rare, 10 fms., mud (1, 2).
P. islandicus beringianus Middendorff, 2 examples (4).
P. (Chlamys) hindsii navarchus Dall, 10 fms., scarce (1).
P. caurinus Gould, 10 fms. (4). Range extension north of Wrangell.
Limatula subauriculata (Montagu), 15 fms., sand (1).
Pododesmus (Monia) macrochisma (Deshayes), 1, 2, 3, 4).
Mytilus californianus Conrad, on surf-beaten rocks (1).
M. edulis Linné, common on all beaches.
Modiolus modiolus (Linné), (1, 2, 3, 4).
Modiolaria nigra (Gray), not common (1).
Modiolaria substriata (Gray), amongst nullipores (1).
Modiolaria laevigata (Gray), in byssal nests, not common (1).
Modiolaria vernicosa Midd., on *Zostera* (1).
Pandora (Kennerlia) filosa Carpenter, dredged (1).
P. (K.) bilirata Conrad, (4). Range extended north of Forrester Island.
Entodesma saxicola (Baird), not common (1, 2, 3).
Lyonsia striata (Montagu), 15 fms., mud (1, 4).
L. pugetensis Dall, 15 fms., mud (1).
Cuspidaria beringensis Leche, one example, 25 fms., shell bottom.
Astarte esquimalti Baird, 18 fms., mud, several (1).
A. arctica (Gray), 18 fms., sand (1).
A. alaskensis Dall, 20 fms., sand (1).
A. rollandi Bernardi, dredged (4).

Venericardia ventricosa (Gould), 20 fms., mud (1, 4).
V. alaskana Dall, dredged (4).
Kellia laperousei (Deshayes), in dead clam shells (2, 4).
K. suborbicularis (Montagu), (2, 4).
Rochefortia planata Dall, 10 fms. (3).
R. tumida (Carpenter), 10 fms. (3).
R. aleutica Dall, 10 fms., mud (4).
Thyasira flexuosa (Montagu), dredged (2).
Clinocardium nuttallii (Conrad), common on sandy beaches.
C. ciliatum (Fabricius), 10 fms., mud, not common (1, 2, 3, 4).
C. californiense (Deshayes), not common (1, 2, 3).
C. fucanum (Dall), 10 fms., rare (4).
Serripes groenlandicum (Gmelin), 20 fms., mud (1, 3).
S. laperousii (Deshayes), dredged, mud, (3, 4).
Protocardia centifilosa (Carpenter), dredged, sand (3).
Saxidomus gigantea (Deshayes), common on sand & mud beaches.
Campsomyax kennerlyi (Carpenter), 15 fms., sand (1).
Protothaca staminea (Conrad), common on stony beaches.
P. staminea orbella (Carpenter), in hard grounds (1, 3).
Lyocyma viridis Dall, rare, on muddy bottom (1).
Macoma middendorffii Dall, rare, muddy bottom (3).
M. incongrua Martens, sandy mud, not uncommon (1, 2).
M. brota Dall, sandy mud, rare (4).
M. brota lipara Dall, sandy mud, dredged, rare (4).
M. inquinata Deshayes, sandy mud, not common (1, 2, 3, 4).
M. balthica (Linné), in mud, not common (1, 2, 3).
M. alaskana Dall, dredged, rare (1, 3, 4).
M. sitkana Dall, dredged, rare (1, 2, 3).
M. nasuta (Conrad), sandy mud beach, not common.
M. inflatula Dall, 10 fms., mud (4).
M. yoldiformis Cpr., dredged (4). Range extend north from Fuca Strait.
Tellina lutea (Gray), not common (2).
T. lutea venulosa Schrenck, (3).
T. salmonea Carpenter, in fine sand (2, 3).
Siliqua patula (Dixon), common on outer sandy beach of Sitkalidak Island.
S. patula alta (Broderip & Sowerby), rare (2).
Saxicava arctica (Linné), common under rocks.
S .pholadis (Linné), under boat rafts and anchored logs.
Bankia setacea (Tryon), at all stations, on sunken pilings and wood.
Phacoides tenuisculpta (Carpenter), dredged (1).
P. annulata (Reeve), dredged (1).
Spisula alaskana (Dall), in sand at low tide (1, 2, 3, 4).
Schizothaerus capax (Gould), Swan, 1953, rare (4).
Mya truncata Linné, scarce at low tide in gravel (1, 3, 4).

M. truncata var. *uddevallensis* Forbes, (4). One example, similar to type lot.
M. intermedia Dall, similar to Kamchatka specimens collected by W. J. Eyerdam.
M. japonica Jay, (4). Easily distinguishable from matura *M. intermedia.*

Scaphopoda

Dentalium dalli Pilsbry & Sharp, 15 fms., sandy mud (4).

Opisthobranchia

Cylichnella alba (Brown), dredged (1, 4).
C. occulta (Mighels), dredged (4).
C. nucleola (Reeve), on eel-grass (4).
C. attonsa (Carpenter), dredged (4).
Acteocina eximia (Baird), 10 fms., sand (1, 3, 4).
Haminoea vesicula (Gould), on eel-grass (5, 6). Range extended north from Vancouver Island.
H. olgae Dall, below tide mark at roots of eel-grasses. (3, 4). Range extended west from Prince William Sound.

Nudibranchia

Melibe leonina (Gould), common amongst eel-grass.
Anisodoris nobilis (MacFarland), on stones, not common (4).

Pteropoda

Spiratella pacifica Dall, on kelp holdfast (4).

Pulmonata

Arctonchis borealis (Dall), on *Fucus* and smooth stones in littoral zone.
Siphonaria (Liriola) thersites Carpenter, on stones and *Fucus,* near shoreline, all stations.

Prosobranchia

Spiroglyphis lituellus Mörch, on stones (1, 4). Range extended north from southeast Alaska.
Aforia circinata (Dall), below tide mark (1).
Bela inequita (Dall), 10-20 fms. (4). *(Bela = Lora.)*
Bela rosea (M. Sars), 10-20 fms. (1, 4).
Bela fidicula (Gould), 10-20 fms. (1).
Bela solida (Dall), 10-20 fms. (1, 4).
Bela turricula (Montagu), 10-20 fms. (1).
Bela scalaris (Möller), 10 fms. (1).
Bela pleurotomaria (Couthouy), 10 fms. (1).
Bela alaskensis (Dall), 10 fms. (1).
Bela sculpturata (Dall), 10-15 fms. (4).
Bela excurvata Carpenter, 10 fms. (4).
Bela nobilis (Möller), 10 fms. (4).
Bela chiachiana (Dall), 10 fms. (2).
Admete couthouyi (Jay), dredged (3, 4).
A. couthouyi gracilior (Carpenter), dredged (1).
Olivella boetica Carpenter, dredged (1, 3, 4).

Chrysodomus lirata (Martyn), 20 fms. (1, 3, 4).
C. pribiloffensis Dall, 10-20 fms. (1, 3, 4).
C. pribiloffensis var. *humboldtiana* Allyn Smith, 10-20 fms., sandy bottom (1, 3, 4).
C. satura (Martyn), 10 fms. (1).
Beringius crebricostatus (Dall), 10-20 fms. (1, 3, 4).
B. eyerdami Allyn Smith, 15 fms. (4). Paratype.
B. kennicotti (Dall), 10 fms., sand (1, 3, 4).
Colus (Latisipho) jordani Dall, 10 fms. (1).
Searlesia dira (Reeve), common under rocks at all localities.

(To be continued)

HETEROPODS AND PTEROPODS AS FOOD OF THE FISH GENERA, THUNNUS AND ALEPISAURUS

By HENRY D. RUSSELL

During the past several years the possibility of a tuna fishery off the western Atlantic coast of North America has become of interest both to sport and commercial fishermen. The presence or absence of these fish is directly related to their food supply and so it becomes of interest to determine its composition. The following discussion is a list of localities with dates and the identification of pteropod and heteropod mollusks taken from the stomach contents of *Thunnus albecares* (Bonnaterre), *Alepisaurus ferox* Lowe and *Alepisaurus brevirostris* Gibbs.

The collections were made during investigative cruises of the motor vessel Delaware. These were carried on under the auspices of the U.S. Fish and Wildlife Service during April, July, September and October of 1957 and March, April, May and July of 1958 in the north and mid-western Atlantic.

For the collection and opportunity to examine the material, I am indebted to Dr. Robert Gibbs of Boston University. For working space and helpful suggestions I wish to acknowledge with thanks the Museum of Comparative Zoology at Harvard, Dr. W. J. Clench, Curator of Mollusks, and Mr. R. W. Foster of that institution.

The accompanying map shows the numbered localities (also see table 1) at which fish were taken while the lists and tables indicate which species of heteropod and/or pteropod mollusk composed part of the stomach contents of either *T. albecares* (Bon.) (list 1) or *A. ferox* Lowe (list 2) or *A. brevirostris* Gibbs (list 3). The species of these mollusks found at each numbered

locality, latitudes and longitudes (see map) are shown in table 1. The species' ranges are shown in table 2. Table 3 shows the months, and which of these species was found in the stomach content of one, two, or all three species of fish.

The heteropod species, *Cardiapoda richardi* Vayssiére was found in the stomach contents of one fish, but the fish was not identified though its stomach content was kept. This species of mollusk is therefore regarded here only as being present on the date it was taken, 7/25/58. Finally, a key to the north and mid-Atlantic heteropods modified from Tesch, 1945, is included to aid in the identification of the several species found in this region. The key contains more species than were found in the fish stomach contents. By this enlargement, it will be a more useful key to those interested in these organisms.

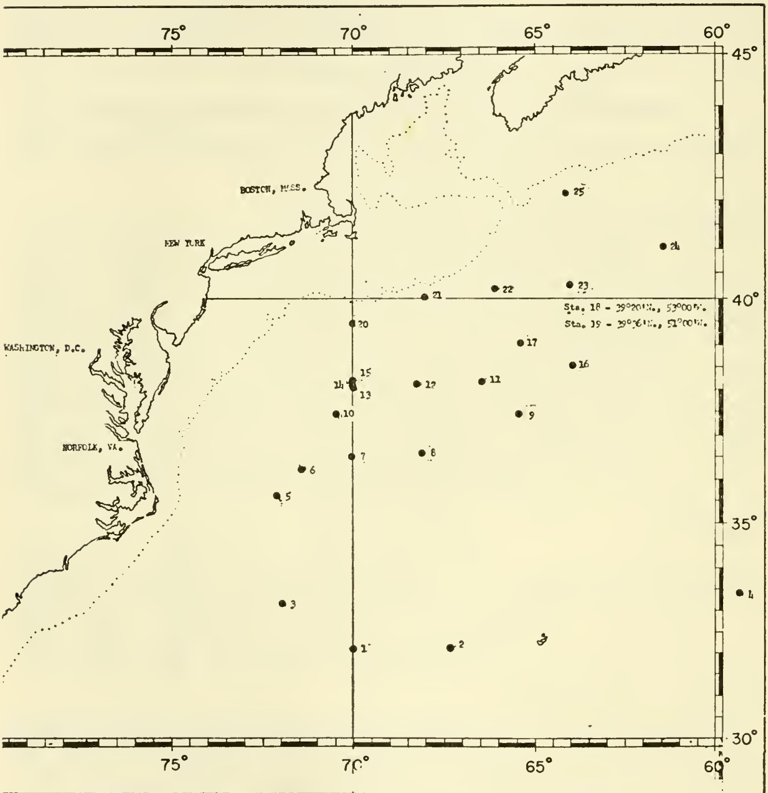
Table 3 indicates that *Cavolina tridentata* Forsk. was eaten by all three species of fish during July to October and *Carinaria lamarcki* Per. and Les. by all three from May to October. *Pterotrachea hippocampus* (Phil.), *P. scutata* Gegen. and *P. coronata* Forsk., on the other hand, were eaten only by *Alepisaurus ferox* Lowe, during July to October. The fishing period extended from March to November. No heteropods were recorded from fish earlier than May. Without a complete monthly seasonal record the explanation of this is difficult. More seasonal record data are needed.

No collections were made later in the year than October so that more seasonal data are needed here also to explain whether the heteropods and pteropods and fish are present or not and whether or not they are forming part of the fish diet during this latter part of the year.

There is little life cycle information recorded in the literature relative to forms found in the western Atlantic. As a result, no one can state whether these heteropods and pteropods grow quickly to full size and maturity or not and what may be their life span. More data in these areas might yield valuable information bearing upon fish food migrations and this in turn upon future fisheries.

The several species and their authors are listed below for reference and make possible the elimination of authors' names from the lists and tables.

Atlanta peroni Lesueur
Oxygyrus keraudreni (Lesueur)
Cavolina tridentata (Forskal)
C. uncinata (Rang)
C. gibbosa (Rang)
C. trispinosa (Lesueur)
Pneumoderma atlanticum Gegenbaur
Carinaria lamarcki Peron and Lesueur
Pterotrachea hippocampus (Philippi)
P. scutata Gegenbaur
P. coronata Forskal
Cardiapoda placenta (Lesson)
C. richardi Vayssiere



• STATIONS FROM WHICH SPECIMENS WERE RECORDED (SEE ALSO TABLE 1)

Key to the North and Mid-Atlantic Heteropods
(Modified from Tesch, J.J. 1949)

A. Flat coiled and keeled shell into which the animal can completely withdraw.
Atlantidae (H)

B. Body too large to be withdrawn into shell which covers the visceral nucleus only; shell triangular.
Carinariidae (L)

C. Shell disappeared; visceral nucleus is very near or at the posterior end of the body.
Pterotracheidae (O)

D. Shell 10 mm or less in diameter, flattened, large outer whorl encircled by a keel; animal can wholly withdraw into shell; tentacles anterior to the eyes.
(F)

E. Shell coiled at tip and consisting chiefly either of a conical more or less straight and keeled last whorl, vestigal, or entirely lacking; animal cannot withdraw into shell, body cylindrical, with large proboscis and swimming fin.
(J)

F. Shell planorboid, cartilaginous, transparent with broad cartilaginous keel.
Oxygyrus Benson *O. keraudreni* (Lesueur)

G. Shell dextral, not planorboid, spire projecting and visible on right side only.
(H)

H. Keel chalky sloping down toward shell mouth.
Atlanta Lesueur (Q)

I. Keel cartilaginous, transparent continued up to shell mouth.
Protatlanta Tesch P. *souleyeti* (Edg. A. Smith)

J. Shell present. Visceral nucleus stalked, above swimming fin.
(N)

K. No shell present, visceral nucleus at or near posterior of body and swimming fin midway between eyes and visceral nucleus.
(P)

L. Shell comparatively large, covering the visceral nucleus and the gills in the mantle cavity, body much inflated.
(N)

M. Shell very small, covering only the nether pole of the visceral nucleus and produced into winglets at the aperture.
Cardiapoda Orbigny
(DD)

N. Body cylindrical.
Carinaria Lamarck
(CC)

O. A distinct tail behind visceral nucleus. No tentacles anterior to eyes.
Pterotrachea Forskal
(GG)

P. Only a small lobe exists behind the visceral nucleus and tentacles are found only in the males.
Firoloida Lesueur (FF)

Q. Shell colorless, flattened, transparent, without spiral sculpture; spire in profile generally not projecting beyond the plane of the last whorl.
(S)

R. Shell usually horny colored, inflated, suture deeper toned; spire rising obliquely from plane of last whorl and bearing a few spiral lines.
(X)

S. Spire deflected with relation to last whorl.
Atlanta inclinata

Souleyet

T. Spire within plane of last whorl (U)

U. 5 whorls
Atlanta peroni Lesueur

V. 4 whorls
Atlanta gaudichaudi Souleyet

W. 3 whorls
Atlanta lesuere Souleyet

X. Spire conical, penultimate whorl spirally sculptured. (Y)

Y. Shell nearly colorless, 6-8 spiral lines on penultimate whorl. (AA)

Z. Shell buff-colored, a few wavy spiral lines near shell mouth tip, also on underside of shell.
Atlanta fusca Souleyet

AA. Suture distinct, not colored.
Atlanta helicinoides Souleyet

BB. Suture distinct, purple colored.
Atlanta inflata Souleyet

CC. Shell depressed, basal length about 65% of greatest height.
Carinaria lamarcki Peron and Lesueur

DD. Gills more than 20, arranged in a row around the outer margin of the visceral nucleus, swim fin homogenous except at free edge where muscle bands appear distinct; tail ending in a star-shaped expansion.
Cardiapoda placenta (Lesson)

EE. Gills few 8-10, on dorsal side of visceral nucleus; swim fin with distinct crisscrossed muscle fibers, tail long, filamentous.
Cardiapoda richardi Vayssiere

FF. Gills absent; tentacles only in males, without appreciable tail behind the visceral nucleus.
Firoloida dismaresti Lesueur

GG. Eyes cylindrical, longitudinal axis including lens distinctly longer than retinal base. (II)

HH. Eyes triangular, length as broad as retinal base. (KK)

II. Visceral nucleus long, slender (4-5 times as long as broad), sharply pointed at tip.
Pterotrachea coronata Forskal

JJ. Visceral nucleus proportionately thicker, anterior part of body much enlarged.
Pterotrachea scutata Gegenaur

KK. Visceral nucleus ½ as broad as long.
Pterotrachea hippocampus (Phillippi)

LL. Visceral nucleus about 3 times as long as broad.
Pterotrachea minuta Bonnevie

List 1

Heteropod or Pteropod Mollusks Found in the Stomach Contents of *Thunnus albecares* (Bonnaterre)

Date	Locality	Species
9/22/57	38°17′N;65°58′W	Cavolina tridentata
10/ 4/57	38°12′N;70°00′W	" "
10/10/57	34°45′N;71°49′W	" "
9/12/57	40°34′N;64°00′W	Carinaria lamarcki
9/12/57	40°34′N;64°02′W	" "
9/14/57	37°44′N;65°42′W	" "
9/21/57	40°27′N;66°15′W	" "
9/22/57	38°07′N;65°58′W	" "
9/22/57	38°07′N;68°15′W	" "
10/ 2/57	36°57′N;68°05′W	" "
10/ 2/57	36°42′N;70°00′W	" "
10/ 2/57	36°57′N;68°05′W	" "
10/ 3/57	36°42′N;70°00′W	" "
10/ 3/57	36°57′N;68°05′W	" "
10/ 8/57	37°45′N;71°49′W	" "
10/ 9/57	36°15′N;71°49′W	" "
10/11/57	34°45′N;73°41′W	" "

List 2

Heteropod and Pteropod Mollusks Found in the Stomach contents of *Alepisaurus ferox* Lowe

Date	Locality	Species
9/25/57	39°44′N;70°00′W	Atlanta peroni
10/ 4/57	38°12′N;70°00′W	" "
9/25/57	39°44′N;70°00′W	Oxygyrus keraudreni
10/ 4/57	38°12′N;70°00′W	" "
9/23/57	38°28′N;68°05′W	Cavolina tridentata
9/25/57	39°44′N;70°00′W	" "
10/ 2/57	36°57′N;68°05′W	" "
10/ 4/57	38°12′N;70°00′W	" "
10/ 3/57	36°42′N;70°00′W	Pneumoderma atlanticum
7/19/58	35°50′N;72°35′W	Carinaria lamarcki
9/17/58	38°16′N;70°00′W	" "
9/27/58	32°06′N;67°32′W	" "
10/ 2/57	36°42′N;70°00′W	" "
10/ 2/57	36°57′N;65°05′W	" "
10/ 2/57	39°00′N;65°20′W	" "
10/ 3/57	36°42′N;70°00′W	" "
10/ 8/57	37°45′N;71°49′W	" "
7/26/58	32°06′N;70°00′W	Pterotrachea hippocampus
7/27/58	32°06′N;67°32′W	" "
10/ 2/57	36°57′N;65°05′W	" "
10/ 3/57	36°42′N;70°00′W	" "

Date	Locality	Species
9/25/57	39°44′N;70°00′W	Pterotrachea scutata
10/ 3/57	36°42′N;70°00′W	" "
10/ 2/57	36°57′N;65°05′W	Pterotrachea coronata
10/ 3/57	36°42′N;70°00′W	" "

List 3

Heteropod and pteropod mollusks found in the stomach contents of *Alepisaurus brevirostris* Gibbs

Date	Locality	Species
7/11/58	37°08′N;66°42′W	Atlanta peroni
7/17/58	38°16′N;68°05′W	" "
7/11/58	37°08′N;66°42′W	Oxygyrus keraudreni
9/22/57	38°07′N;65°58′W	" "
9/25/57	39°44′N;70°00′W	" "
7/11/58	38°07′N;66°42′W	Cavolina tridentata
9/11/57	42°18′N;64°02′W	" "
9/14/57	37°44′N;65°42′W	" "
9/22/57	38°07′N;65°58′W	" "
9/25/57	39°44′N;70°00′W	" "
10/ 4/57	38°12′N;70°00′W	" "
10/ 8/57	37°45′N;71°49′W	" "
7/11/58	37°08′N;66°42′W	Cavolina uncinata
7/14/58	37°44′N;65°42′W	" "
9/25/57	39°44′N;70°00′W	" "
7/11/58	37°08′N;66°42′W	Cavolina gibbosa
7/17/58	38°16′N;70°00′W	" "
9/11/57	42°18′N;64°02′W	" "
9/25/57	39°44′N;70°00′W	" "
7/11/58	37°08′N;66°42′W	Cavolina trispinosa
9/25/57	39°44′N;70°00′W	Pneumoderma atlanticum
7/11/57	37°08′N;66°42′W	Carinaria lamarcki
9/11/57	42°18′N;64°02′W	" "
9/17/58	38°16′N;70°00′W	" "
10/18/57	37°45′N;71°49′W	" "
9/25/57	39°44′N;70°00′W	Cardiapoda placenta

Table 1

Heteropod and pteropod species listed by locality

Sta. No.	Locality	Species
1	32°06′N;70°00′W	Pterotrachea hippocampus
2	32°06′N;67°32′W	" "
		Carinaria lamarcki
3	33°06′N;72°10′W	Cardiapoda richardi
4	33°40′N;59°40′W	Pterotrachea hippocampus
5	35°50′N;72°35′W	" "
		Carinaria lamarcki
6	36°15′N;71°49′W	" "

Sta. No.	Locality	Species
7	36°42′N;70°00′W	Pterotrachea coronata
		Carinaria lamarcki
		Pterotrachea scutata
		Pterotrachea hippocampus
		Pneumoderma atlanticum
8	36°57′N;68°05′W	Cavolina tridentata
		Cardiapoda placenta
		Carinaria lamarcki
		Pterotrachea hippocampus
		Pterotrachea coronata
9	37°44′N;65°42′W	Carinaria lamarcki
		Cavolina uncinata
		Cavolina tridentata
10	37°45′N;71°49′W	Carinaria lamarcki
		Pneumoderma atlanticum
		Cavolina tridentata
11	38°07′N;66°42′W	Carinaria lamarcki
		Cavolina uncinata
		Cavolina gibbosa
		Cavolina trispinosa
		Cavolina tridentata
		Oxygyrus keraudeni
		Atlanta peroni
12	38°07′N;68°15′W	Carinaria lamarcki
		Cavolina tridentata
		Oxygyrus keraudreni
13	38°12′N;70°00′W	Cavolina tridentata
		Oxygyrus keraudreni
		Atlanta peroni
14	38°16′N;70°00′W	Carinaria lamarcki
		Cavolina gibbosa
		Atlanta peroni
15	38°28′N;68°05′W	Cavolina tridentata
16	38°49′N;64°02′W	Pterotrachea coronata
		Carinaria lamarcki
		Cavolina gibbosa
		Cavolina tridentata
		Oxygyrus keraudreni
17	39°00′N;65°20′W	Carinaria lamarcki
18	39°20′N;53°00′W	" "
19	39°36′N;51°00′W	Pterotrachea coronata
		Carinaria lamarcki
20	39°44′N;70°00′W	Cardiapoda placenta
		Pterotrachea scutata
		Cavolina uncinata

		Cavolina gibbosa
		Cavolina trispinosa
		Cavolina tridentata
		Oxygyrus keraudreni
		Atlanta peroni
21	40°00′N;68°05′W	Pterotrachea coronata
		Carinaria lamarcki
		Cavolina uncinata
		Cavolina gibbosa
		Cavolina trispinosa
		Cavolina tridentata
		Oxygyrus keraudreni
22	40°27′N;66°15′W	Carinaria lamarcki
		Cavolina uncinata
		Cavolina gibbosa
		Cavolina tridentata
		Oxygyrus keraudreni
23	40°34′N;64°02′W	Pterotrachea hippocampus
		Carinaria lamarcki
		Cavolina tridentata
		Pterotrachea scutata
24	41°00′N;61°45′W	Pterotrachea scutata
		Pterotrachea hippocampus
		Pterotrachea coronata
		Carinaria lamarcki
25	42°18′N;64°02′W	Carinaria lamarcki
		Cavolina gibbosa
		Cavolina tridentata

Table 2

Specific Ranges for the Species of Heteropods and Pteropods

Species	Latitude	Longitude
Atlanta peroni	37°08′N-40°00′N —	66°42′W-70°00′W
Oxygyrus keraudreni	37°08′N-40°27′N —	64°02′W-70°00′W
Cavolina tridentata	34°45′N-42°18′N —	64°02′W-71°49′W
Cavolina gibbosa	37°08′N-42°18′N —	64°02′W-70°00′W
Cavolina trispinosa	37°08′N-40°00′N —	66°42W′-70°00′W
Cavolina uncinata	37°08′N-40°27′N —	65°42′W-70°00′W
Pneumoderma atlanticum	36°42′N-37°45′N —	70°00′W-71°49′W
Carinaria lamarcki	32°06′N-42°18′N —	51°00′W-73°41′W
Pterotrachea coronata	36°42′N-57°36′N —	51°00′W-70°00′W
Pterotrachea hippocampus	32°06′N-57°36′N —	59°40′W-72°35′W
Pterotrachea scutata	36°42′N-40°34′N —	61°45′W-70°00′W
Cardiapoda richardi	33°06′N-72°10′W	
Cardiapoda placenta	36°44′N-39°44′N —	68°05′W-70°00′W

Table 3. The months during which certain species of heteropods and pteropods were recorded from the three species of fish.

Species of heteropod or pteropod	Species of fish: Thunnus albecares	Alepisaurus ferox	A. brevirostris
Oxygyrus keraudreni	Sept.	Sept., Oct.	July, Oct.
Atlanta peroni		Sept., Oct.	July
Carinaria lamarcki	May, Sept., Oct.	July, Sept., Oct.	July, Sept., Oct.
Cardiapoda placenta	Oct.		Sept.
Cardiapoda richardi			
Pterotrachea hippocampus		July, Oct.	
Pterotrachea scutata		Sept., Oct.	
Pterotrachea coronata		Oct.	
Pneumoderma atlanticum		Oct.	Sept.
Cavolina uncinata			July, Sept.
Cavolina gibbosa	Sept.		July, Sept.
Cavolina tridentata	Sept., Oct.	Sept., Oct.	July, Sept., Oct.

Bibliography

Bronn, H. G., Klassen und Ordnungen des Tier-Reichs, Band III, Mollusca (opisthobranchia). pp. 281-294, 304, 306, 307, 321-351, 407-412, 437-441, 567, 622, 1044. pls. 9, 10, 1896-1907.

Johnson, C. W., List of the marine mol. of the Atlantic coast from Labrador to Texas. Proc. Bost. Soc. Nat. Hist. 40. No. 1. p. 92-93, 151, 1934.

Tesch, J. J. Dana report No. 34, Heteropoda. pp. 5-54, pls. 1-5. Oxford Univ. Press. London, 1949.

Tesch, J. J. Dana Report No. 28, The thecosomatous pteropods (the Atlantic). p. 3-81, pls. 1-8, 1946.

Eydoux et Souleyet. La Bonite, Voyage autour du monde. Pterapodes, pp. 37-288, Heteropodes, pp. 289-392, 1852.

Rang, P.C.A.L. and Souleyet. Hist. nat. des mol. pteropodes. pp. 1-86, pls. 1-15, 1852.

Smith, E. A. Report on the heteropods collected by HMS. Challenger during the years 1873-76.

Vayssiére, A. Mol. heteropodes. Yachts Herondelle et Princess Alice. pp. 3-65, pls. 1-6, 1904.

GALACERA, NEW GENUS OF POLYCERID NUDIBRANCHS

By CARLOS J. RISSO-DOMINGUEZ

When searching for nudibranchs in the port of Mar del Plata in January, 1957, opportunity arose to collect two specimens of a polycerid, immediately recognized in the field as a new genus closely allied to *Thecacera* and *Polycera*. The name *Galacera* was selected at that time. Surprisingly, I further realized that this curious polycerid is the same nudibranch described by Franceschi (1928) as a variety of *Polycera quadrilineata* and reported by Odhner (1941) as a distinct species. This was evident after a careful consideration of the causes for the incomplete description by Franceschi and an examination of the type material in the Museo Argentino de Ciencias Naturales.

The imaginary animal described by Odhner and Franceschi belongs to *Polycera,* but the real nudibranch found by the latter (no. 17206, Invert. Div. MACN) and observed alive by the writer in the type locality, markedly differs from the diagnosis elaborated by Odhner (1941:16) and some original figures.

The paper by Franceschi only meant to claim the presence of the well known European polycerid sea-slug on the Atlantic coast of South America, with the pretense that it was the first record of

the genus for this coast.[1] To force this assumption, the animal was described as a variety because the author was unable to avoid or neglect the conspicuous differences. This author apparently did not consult detailed color plates, illustrating the most common European polycerid, and the supposed resemblance with *P. quadrilineata,* chiefly was a matter of conjecture. Only the comparison with pl. 22 (Fam. 1) of Alder and Hancock (1851) or pl. *"P. quadrilineata"* by Meyer and Möbius (1865), might have supplied the certainty of the distinctness of the specimens as belonging to a new species.

The work by Franceschi is rather contradictory. He early states that the specimens do not show appreciable differences from those of European coasts (p. 580). Nevertheless he is further perplexed because he was unable to find any trace of tubercles or similar structures in living specimens (p. 584). The inconsistency of important details between some figures and the text is obvious; e.g., 8-10 digitations are indicated for adult specimens, but the animal depicted in the plate has only 6 veil digitations and probably an author, who had an ample supply of adult specimens, would not select a young one for the illustrations. No word about the pallial margin is given, but a very exaggerated one is depicted in the figures, and no description is provided for the rhinophores, quite overlooking the retractility into sheaths, a rather important diagnostic character in nudibranchs. Even if Franceschi had a good number of living specimens before him, he evidently overlooked this feature, of high taxonomic value, in his attempt to identify them with *Polycera quadrilineata.*

Even more difficult to justify (and really mystifying) is the diagnosis by Odhner (1941)[2]. Since Odhner did not have any living or preserved material and his only source of knowledge was the paper by Franceschi, such an imaginary diagnosis might

---

1 This error recently was repeated by Marcus (1955). As early as in 1854, Alder and Hancock (1854) mentioned a *Polycera* from Brazil (". . . Of extra European species, one occurs in the Canary Islands, another on the coast of North America, and a third in Rio de Janeiro . . .") that might be described in some account of earlier travels. Either *Polycera odhneri* Marcus, 1955, or *Polycera hummi* Abbott, 1952 (=*P. aurisula* Marcus, 1957) might be a synonym of that species.

2 ". . . Back margin *very distinct,* smooth. Frontal processes at least 6. Back surface with indistinct *tubercles.* Colour whitish, with series of *yellow spots* on back, sides and tail (*each a minute tubercle*) frontal digitations yellow, *red in the middle, . . .*"

have been the direct result of a misinterpretation of the Spanish text. The "very distinct" pallial ridge came from the wrong figures, but Franceschi did not mention the presence of tubercles, indistinct or minute. The veil digitations are yellow from the base to the tip, and no "red in the middle" is present. The lines of spots in the body are scarlet red, not yellow. Obviously, this is very clear in the original paper and corresponds in all details with the specimens studied by me in 1957. Consequently, I cannot accept Odhner's diagnosis or take into account the relationship or taxonomic position given by him for this nudibranch.

GALACERA, genus novum.

Type species: Polycera marplatensis (Franceschi). Belonging to the group *Thecacera-Polycera-Ohola* in the sense of Odhner (1941, p. 11)[3]. Body limaciform, smooth, resembling *Polycera* at certain extent, but rather high, without tubercles or tuberculate pallial margin. Rhinophores very small, without the conspicuous differences between clavus and stalk shown in *Polycera,* fully retractile into narrow sheaths with indistinct borders; disappearing below the skin level when retracted, the sheaths being closed by a sphincter-like action of the borders. Indistinct pallial margin, almost reduced to the dorsal sloping borders, and not continued behind the branchiae. Foot prehensile, which makes difficult crawling on a flat surface, such as glass.[4]

Galacera mainly differs from *Polycera* by the retractile rhinophores within sheaths and the lack of a tuberculate pallial margin. From *Thecacera,* it differs by the absence of the typical large sheaths of this genus. Like *Trevelyana, Crimora* and *Ohola, Galacera* has small rhinophores, retractile into narrow or indistinct sheaths. *Galacera marplatensis* has some external resemblance in morphology and colouring with *Polycera quadrilineata*[5] and Odhner (1941) places it in the group *quadrilineata-capensis-atra* but, in addition to the generic differences, this species does not show the black pigmentation that is a noteworthy peculiarity in the group formed by these 3 species.

The coloration resembles more that found in the species of *Trevelyana* with opaque white background and scarlet red spots.

---

3 United by the similarity of radula and jaws.

4 The taxonomic value of this peculiarity is not yet fully known in the *Polyceridae,* because no data are available for most species.

5 Chiefly by the yellow frontal digitations and yellow tipped extra-branchial appendages.

A species with retractile rhinophores and without tuberculate pallial margin cannot possibly be included in *Polycera.*

Since the very clear diagnosis for *Polycera* by Alder and Hancock (1854, 1855), the non-retractile rhinophores and the absence of sheaths has been recognized by authors as a sharp and distinguishing diagnostic character for the genus, and Odhner also mentioned it (1941, p. 11). The term "retractile" used by Vayssiére (1901, p. 61 and 1913, p. 339) for *Palio* and Risbec (1928, p. 201) for *Polycera picta,* must be taken as "contractile." Evidently, there is an obvious difference between a rhinophore or a tentacle that contracts as a very sensitive organ, and a rhinophore which completely enters into a sheath (= invaginable).

Moreover, there are no species of *Polycera* without tubercles or a tuberculate pallial margin. The diagnosis by Alder and Hancock (1855, p. xviii) proved to be right after one century of research on polycerids. All the species in this genus divide naturally into three groups: (1) One includes all those species with a brownish pigmentation, from a reddish hue *(P. japonica, P. cooki)* to an olivaceous, greenish one, or even yellowish-green *(P. lessonii, P. ocellata, P. picta, P. risbeci),* with numerous tubercles in the pallial margin and mostly with a very tuberculate skin. This group comprises: *P. lessonii* D'Orb., 1837; *P. ocellata* A. & H., 1842; *P. cooki* Angas, 1864; *P. zosterae* O'Donoghue, 1924; *P. picta* Risbec, 1928; *P. faroensis* Lemche, 1929; *P. fujitai* Baba, 1937; *P. risbeci* Odhner, 1941; *P. japonica* Baba, 1949; *P. maculata* Pruvot-Fol, 1951; *P. hummi* Abbott, 1952; *P. odhneri* Marcus, 1955; and *P. priva* Marcus, 1959[6]. The whole group (by far the most numerous in species) can be included in *Palio* if an amended diagnosis is provided for this subgenus.

(2) The second includes the blue-yellow pigmented polyceras or in other words, the subgenus *Greilada. P. (G) elegans* (Bergh), 1894; *P. (G.) messinensis* Odhner, 1941 *and P. (G.) atlantica* Pruvot-Fol, 1955, have been described, being all doubtful, rare or with very unsatisfactory descriptions. See Pruvot-Fol (1955).

(3) To the third group belong the white-yellow-black forms, that are *P. quadrilineata* O. Müller, 1776; *P. capensis* Quoy and

[6] Only with hesitation, I include *P. priva* in this list, because the species is based upon examination of only one very contracted, preserved specimen, with all the inconveniences of such material. It is rather unfortunate that "Bergh's style" in creating species could still be used.

Gaimard, 1824 and *P. atra* MacFarland, 1905[7], or the subgenus *Polycera sensu stricto.* This relationship is recognized by Pruvot-Fol (1954) in her description of *P. quadrilineata*[8]. They have large and conspicuous yellow frontal digitations, a character in common with *Galacera marplatensis.* They could be interpreted as the connecting linkages, from this restricted standpoint, with *Thecacera, Galacera and Trevelyana,* genera which include species with white backgrounds and orange-yellow or red spots. Noteworthily, the shape of the animal is also intermediate. *P. atra* and *P. capensis,* with their tendency towards disappearance of the pallial margin and tubercles, do resemble, more than other polyceras, *Thecacera pennigera, Galacera marplatensis* and *Trevelyana alba,* if the sharply distinguishing, generic peculiarities be overlooked.

Moreover, there are true tubercles in the pallial margin of *P. capensis,* even if not recognized by Odhner (1941) and Barnard (1927). To apply an unequivocal terminology to identify each of these different structures is of paramout importance in the taxonomy of this family. The terms used by some authors, such as "papillae" and "processes," must be abandoned and only "tubercles," "veil digitations" and "extrabranchial appendages" be used. The "flanking processes" (= extrabranchial appendages) of Barnard (1927, p. 191-192) for *P. capensis* (= *P. nigrocrocea)* are real tubercles, obviously equal in structure as those of *P. atra,* very clearly described in the correct sense by MacFarland (1906, p. 142). In *Polycera* the tubercles of the pallial margin (or even the appendage-like tubercles), are pigmented with the same colour as the veil digitations, a fact that may indicate identical histological structure, whereas the true appendages in *Ancula, Trapania, Polycera, Galacera, Thecacera,* etc. are of the same color as the background of the body, and additional, superficial pigmentation is also similar in the branchiae and the body. I must conclude, consequently, that no species of *Polycera* has tubercles in the pallial margin[9], whereas *Galacera* has appendages but no tubercles of any kind. Those reported by

---

[7] *P. pallida* Bergh, 1880 is not included here since it is a very doubtful species, founded upon insufficient evidence.

[8] ". . . et des especes vicariantes au Cap et en Californie . . ."

[9] In *Greilada,* one must take into account living specimens only, which as described by Pruvot-Fol (1951, 1955) have conspicuous tubercles in the pallial margin, and not the preserved specimens of Bergh and Odhner.

Odhner for *G. marplatensis* are imaginary. Franceschi has very clearly stated the lack of any trace of tubercles in living specimens (p. 584),[10] an observation corroborated by my research in 1957.

This nudibranch, the only known polycerid in the puelchean malacological zone of the Argentine coasts, lives on *Bugula* and little differences could be found with the habitat mentioned for *Thecacera pennigera* in Brazil by Marcus (1957), except that I have found it only on those arborescent bryozoan colonies on which it feeds. This explains the prehensile nature of the foot. Strangely enough, the spawning season comes during the coldest weeks of winter, rather than in summer months as do those of most opisthobranchs and all other nudibranchs observed at that locality.

References

Alder, J. and Hancock, A. 1851. Part V, Monograph British Nudibr. Moll.

—— 1854. Part VI, Monograph British Nudibr. Moll.

—— 1855. Part VII, Monograph British Nudibr. Moll.

Angas, G. F. 1864. Journ. de Conchyl. *4*:43-70.

Baba, K. 1937. Jour. Dept. Agric. Kyushu Imp. Univ., *5*:289-344.

—— 1949. Opisthobranchia of Sagami Bay, (Iwanami Shoten), Tokyo.

Barnard, K. H. 1927. Ann. South-African Mus., *25*:171-215.

Bergh, R. 1880. Proc. Acad. Nat. Sci. Phil. *32*:40-127.

Eliot, C. 1910. Part VIII (Supplement.) Monograph British Nudibr. Moll.

Franceschi, G. J. 1928. Anales Mus. Nac. Hist. Nat. Buenos Aires, *34*:577-586.

MacFarland, F. M. 1906. Bull. Bureau Fisheries, Washington, *25*:109-151.

Marcus, E. 1955. Bol. Fac. Fil. Univ. Sao Paulo, Zool. no. 20:89-200.

—— 1957. Jour. Linn. Soc. London, *43*:390-486.

—— 1959. Lunds Univ. Arsskr. N.F., Avd. 2, *55*(9):1-134.

Meyer, H. A. and Möbius, K. 1865. Fauna der Kieler Bucht, *I*, (W. Engelmann) Leipzig.

Odhner, N. H. 1941. Göteb. K. Vet. Vitterh. Samh. Handl. F. 6, (B) *1*(11):1-20.

Pruvot-Fol, A. 1951. Arch. Zool. expér. et gén. *88*(1):1-79.

—— 1954. Faune de France, *58:* Moll. Opisthobranchs, 448 pp.

—— 1955. Bull. Soc. Zool. France, *80*:350-359.

Quoy, J. R. C. and Gaimard, P. 1824. Voyage Uranie et Physicienne, Zoologie.

[10] ". . . no hay tuberculos apreciables sino manchas coloreadas . . ."

Risbec, J. 1928. Faune Colon. Franc. *2*(1):1-238.
Vayssiére, A. 1901. Ann. Mus. Hist. Nat. Marseille, *6*(1):1-130.
—— 1913. Mollusques de la France (1) (Encyclop. Scient. O. Doin) Paris.

LAND SNAILS FROM THE DOE RUN CREEK AREA, MEADE COUNTY, KENTUCKY

By MICHAEL F. KAPLAN and W. L. MINCKLEY [1]

The terrestrial molluscan fauna of Kentucky is known largely from early descriptions of species and from collections that have been recorded in publications dealing with other areas of the United States. This paper lists the species of land snails, exclusive of the slugs, that we have identified from collections made at five sites along Doe Run Creek, Meade County, Kentucky, in the months of March, April, and December, 1959.

Methods and description of the area: Most of the specimens recorded here were picked by hand from stream-drifted debris along Doe Run Creek. However, many specimens were obtained from logs, beneath rocks, and beneath leaf litter and humus in wooded areas. Identifications were made by use of keys published by F. C. Baker (1939) and Pilsbry (1939-1948), with only shell characters being used.

The Doe Run Creek area is located in the Pennyrile region of Kentucky, and is underlain almost entirely by limestones of Missisippian age. Doe Run begins as a spring located at 37° 56′ N and 86° 07′ W, and enters the Ohio River near 38° 00′ N and 86° 06′W, about 3.5 miles east of Brandenburg, Kentucky. The latter two localities were our stations I and V, respectively. Other stations were as follows: Station II—37° 57′N and 86° 07′ W. Station III (approximately same coordinates as Station II, but about one mile north). Station IV—37° 58′ N and 86° 06′ W (determined from U. S. Geological Survey. Topographic Maps: Rock Haven quadrangle—Stations I, III, IV; Guston quadrangle—Station II; and Laconia quadrangle—Station IV).

Much of the valley floor in the Doe Run Area, and also the karsted uplands, is cultivated, with a fringe of trees persisting as a riparian forest. Wooded areas also occur on the precipitous hillsides along the creek, in areas of limestone outcroppings, and

[1] Contribution No. 32 (New Series) from the Department of Biology, University of Louisville, Louisville, Kentucky.

in sections where the valley is too narrow for cultivation. The area has been heavily logged, with most of the timber being second-growth oak, hickory, and maple. Red cedar occurs in scattered stands, and is most abundant on the bluffs and in areas of more recent logging. Some sycamore, oak, and American beech appear as mature stands adjacent to the creek.

Annotated list of species: The notes in this list consist of a term indicating the general abundance of the species in our collections (Rare—fewer than 10 specimens collected. Common—10 to 50 specimens collected. Abundant—more than 50), and the numbers of the stations at which the species was obtained. In some cases, annotations dealing with ecology and morphology are included. Nomenclature, and the arrangement of the list, follow that of Pilsbry *(loc. cit.)* insofar as possible. Representative specimens of each species are deposited with the University of Louisville, Department of Biology.

Polygyra plicata Say. Abundant; stations I, III, IV, and V.

Stenotrema stenotrema (Pfeiffer). Rare; station V. The Doe Run Area apparently lies on the western periphery of the range of this species in Kentucky: Pilsbry (1940) recorded the range as "eastern two-thirds (of Kentucky), west to Jefferson, Hart, and Barren counties."

S. angellum Hubricht. Common; stations III and V. Two of the localities given by Hubricht (1958) are in Meade County, with one being near the Doe Run area ("Ohio River bluff, 5 miles east of Brandenburg").

S. hirsutum (Say). Rare; station III.

S. fraternum (Say). Rare; station V.

Mesodon thyroidus (Say). Common; stations I, III, IV, and V. All but 2 of the 37 specimens of *M. thyroidus* that we obtained were not dentate.

M. clausus (Say). Rare; station V.

M. zaletus (Binney). Common; stations I, II, III, and V.

M. elevatus (Say). Rare; station I.

M. inflectus (Say). Abundant; stations III, IV, and V. Three shells of our series of *M. inflectus* have the gap between the lip-teeth narrower than deep; however, the other specimens have a gap that is consistently wider than deep. That two "populations," exhibiting the differences noted above, exist together was noted by Pilsbry (1940).

Triodopsis fraudulenta (Pilsbry). Rare; station I.

T. denotata (Férussac). Rare; stations I and V. One specimen in our series has the umbilicus open by a narrow cleft under the reflected lip. Pilsbry (1940) noted the occurrence of this anomaly in certain populations of this species.

T. albolabris (Say). Common; stations I, II, III, and IV.

Haplotrema concavum (Say). Common; stations I and V.

Euconulus fulvus (Müller). Common; stations I, II, and IV. This small species was the most abundant form at station IV in the stream-drifted debris. We also obtained the species beneath leaf litter and humus in the wooded areas.

E. chersinus (Say). Rare; stations I and II.

Retinella electrina (Gould). Rare; all stations.

R. wheatleyi (Bland). Rare; stations I and II.

R. indentata (Say). Abundant; stations I and V.

Mesomphix inornatus (Say). Rare; stations I and II. This species was taken only in areas of deep humus deposition near decomposing logs.

M. vulgatus H. B. Baker. Rare; station I.

M. friabilis (W. G. Binney). Rare; stations I and V.

M. ruidus Hubricht. We failed to obtain *M. ruidus* from our localities. Hubricht (1958) described this species from material collected on the "Ohio River flood-plain, just east of Brandenburg (holotype and paratypes)."

Paravitrea multidentata (Binney). Rare; station II.

Hawaiia minuscula (Binney). Common; stations II, IV, and V.

Ventridens demissus (Binney). Rare; stations I and V.

V. ligera (Say). Rare; stations I and V.

Anguispira alternata (Say). Rare; station V.

A. kochi (Pfeiffer). Abundant; all stations. Although this large species occurred at all localities, it was most abundant on the wooded slopes in the upper reaches of the Doe Run Creek watershed.

Discus cronkhitei (Newcomb). Rare; station I.

Helicodiscus parallelus (Say). Rare; stations I and V.

H. singleyanus (Pilsbry). Common; stations III and V.

Oxyloma retusa (Lea). Rare; station I.

Strobilops labyrinthica (Say). Common; stations I, III, IV, and V.

Gastrocopta armifera (Say). Abundant; stations I, III, IV, and V.

G. contracta (Say). Rare; station III.

G. pentodon (Say). Rare; station III.

G. tappaniana (C. B. Adams). Rare; station III.

G. procera (Gould). Rare; station III.

Pupoides albilabris (C. B. Adams). Common; stations I, III, and IV.

Vertigo tridentata Wolf. Rare; stations I and V.

Cionella lubrica (Müller). Abundant; all stations.

Pomatiopsis lapidaria (Say). Abundant; all stations. We collected living specimens of this species from the bottom of the creek in March and December. The latter occurrence was in a bottom sample obtained from 5 feet of water. The species was also found living along the stream banks, sometimes as far as 40 yards from the creek.

Carychium exiguum (Say). Rare; station V.

Summary

Terrestrial mollusks, exclusive of slugs, were collected from 5 localities in the Doe Run Creek area, Meade County, Kentucky. The area is located east and southeast of Brandenburg. Collections were made in March, April, and December, 1959.

Forty-four species of snails were obtained from the area. The species are referable to 22 genera and 10 families. Annotations include the stations at which each species was collected and notations as to the relative abundance.

Literature cited

Baker, Frank C. 1939. Fieldbook of Illinois Land Snails. Ill. Nat. Hist. Surv., Manual 2, Urbana. 166 pp.

Hubricht, Leslie. 1958. New species of land snails from the eastern United States. Trans. Kentucky Acad. Sci., vol. *19*(3-4), pp. 70-76.

Pilsbry, Henry A. 1939, 1940, 1946, 1948. Land Mollusca of North America (north of Mexico), vols. 1 & 2, parts 1 & 2. Acad. Nat. Sci. Philadelphia, Monographs, no. 3.

VOYAGE OF THE VENUS

By J. LOCKWOOD CHAMBERLIN

U. S. Fish and Wildlife Service, Washington, D. C.

In 1836 the French Government sent the frigate Vénus on an extensive voyage in the Pacific ocean. After 30 months, the ship, having sailed around the world, returned to France. Although the principal objectives of the venture were not disclosed, notable

scientific accomplishments were reported (1). These included charts of bays and islands, geophysical and astronomical studies, and natural history collections.

The mollusks fiom the voyage, collected by Du-Petit-Thouars and his first officer, Chiron, included almost 400 species (over 1500 specimens) and had been catalogued in the Muséum d'histoire naturelle, Paris, by 1840 (1). Several years later, Achille Valenciennes published figures of about 86 of the species, accompanied by binomial Latin names in the captions (at least 62 new names) on 27 immense plates in an atlas of the zoological collections (2). Written descriptions of the vertebrate species in the atlas were later published, but none ever appeared for the invertebrates (mollusks, coelenterates, and echinoderms). The new species of mollusks are thus based solely on the figures and are essentially without locality data. Fortunately the figures are excellent. They represent, at least for the most part, shallow water species of the Indo-Pacific and the west coasts of the Americas.

Type specimens of several of the species have been identified in the collections of the Paris museum (3, 4). The locality data with the specimens are often broad (e. g., "Asie," "Kamtschatska," "Nouvelle-Zélande"). Data are missing with some.

I am presenting an itinerary of the Vénus, based on an early report of the voyage (1). Others may find this list useful when designating type localities for Valenciennes' species. The place names are translated into modern English usage, with the French equivalent given in parentheses when notably different. Arrival and departure dates are given when known. An asterisk (*) marks those localities of uncertain chronology. I am especially doubtful of when the Venus could have visited Easter Island in the Pacific, if indeed "Ile de Paques" refers to that place. The ship probably did not stop actually at some of those localities listed below without dates.

Localities:	*Arrival and Departure Dates*
Departed from Brest, France	Dec. 29,1836
Santa Cruz de Tenerife, Canary Is.	Jan. 9-10, 1837
Rio de Janeiro, Brasil	Feb. 4-16
Sailed around Cape Horn	March 21
Valparaiso, Chile	April 26-May 13
Callao, Chile	May 25-June 2

Honolulu, Hawaii	July 9-25
*?Krusenstern Rock, Hawaii	. . . . . .
Avacha Bay, Kamchatka	Aug. 30-Sept. 15
Monterey and San Francisco, Calif.	Oct. 18-Nov. 14
Guadalupe Island, Mexico	. . . . . .
Magdalena Bay, Lower Calif.	Nov. 25-Dec. 7
Mazatlan, Mexico	Dec. 12-18
San Blas, Mexico	Dec. 20-27
Acapulco, Mexico	Jan. 7-24, 1838
*?Easter Is. ("ile de Paques")	. . . . . .
*Juan Fernandez Is. (off Chile)	. . . . . .
*San Felix & San Ambrosio Is.	. . . . . .
Valparaiso, Chile	Mar. 18-Apr. 28
Callao, Peru	May 10-?
Paita, Peru	June 6-17
Galapagos Is.	June 21-July 15
Marquesas Is.	(after Aug. 14)
Papeete, Tahiti Is. & Tubuai-Manu Is., Society Is.	Aug. 29-Sept. 17
*Maria Island ("Hul"), Tubuai Is.	. . . . . .
*Mangaia and Rarotonga Is., Cook Is.	. . . . . .
Bay of Islands, New Zealand	Oct. 11-Nov. 14
Port Jackson, New South Wales	Nov. 23-Dec. 18
Passed south of Tasmania	Jan. 6, 1839
Reunion Island ("ile de Bourbon"), Indian Ocean	March 5-9
False Bay, Union of South Africa	Mar. 29-Apr. 22
Saint Helena Is.	May 7-11
Ascension Is.	May 16
Arrived at Brest, France	June 24, 1839

References

1. Beautemps-Beaupré (C.F.), (H.M.D.) de blainville, and E. de Beaumont, 1840. Rapport sur les travaux scientifiques exécutés pendant le voyage de la frégate la Vénus, commandée par M. le capitaine de vaisseau Du-Petit-Thouars. Comptes Rendu Acad. Sci., Paris. *11*(8)298-343.
2. Valenciennes, (A), 1846[1]. In M. A. Du-Petit-Thouars. Voyage Autour du Monde sur la Frégate la Vénus Pendant les Annes 1836-1839. Atlas de Zoologie, Mollusques, pl. 1, 1 bis, 2, 2 bis, 3, 3 bis, 4-24.

[1] The title page is dated 1846. Sherborn accepted that date for all the new species, having evidence that publication of the plates was completed that year (letter to W. H. Dall and pasted in a copy of the atlas in the U. S. National Museum). A note in Revue zoologique, Paris, 9, Fev. 1846, p. 82, states that the plates were issued in fascicles [dated?] of five and that 26 of the molluscan plates had appeared. Very likely some fascicles containing molluscan plates were issued before 1846.

3. Lamy, E., 1922. Révision des Carditacea vivants du Muséum national d'Histoire naturelle de Paris. Jour. de Conch. *66*:218-368, pl. 7-8.
4. Fisher-Piette, E. and J. Beigbeder, 1943. Catalogue des types de gastéropodes marins conservés au Laboratoire de Malacologie. 1 and 3. Bull. Mus. nat. Hist. Paris, (2 sér.) 15(4):203-209; (6):429-436.

THE GENUS BULIMULUS IN SOUTHERN TEXAS

By LESLIE HUBRIGHT

Because of their habit of estivating on the vegetation, the land snails of the genus *Bulimulus* are the most conspicuous species in southern Texas. Their white shells stand out against the darker background of shrubs or fence posts. One has but to drive along the highway to locate colonies. As a result, material for study is easily obtained, and the author obtained a large series of collections of this genus. Study of this material has indicated a need to revise the status of some of the subspecific names, and to give additional information on their ranges.

Bulimulus schiedeanus (Pfeiffer).

This species is known in the United States only from the lower Big Bend region in the vicinity of Terlingua, Brewster County.

Bulimulus alternatus (Say).

This species is common in southern Texas, ranging north to near Woodsboro in Refugio County, thence northwestward to near Elmendorf in Bexar County and westward to Marfa, Presidio County.

In the vicinity of Roma and Falcon Dam, the shells are small, thick, with a well developed columellar tooth, and the interior of the shell deep brown. Away from this center the shells become larger, thinner, and the tooth becomes very small or wanting. Along the northern and western limits of the range the shells are large, moderately thin, without a columellar tooth, and the interior usually rather pale yellowish-brown. In the vicinity of Port Isabel, Cameron County, shells are very thin and toothless, and are not distinguishable from typical *B. alternatus*. In Brooks and Kenedy Counties, there is a variety in which the shells are large with a distinctly shorter spire. In view of this variation, it does not seem practical to retain the subspecific name *mariae*.

Shells from the lower Rio Grande Valley are usually more highly colored than shells from farther west, but this appears to

be due to the presence of shade. The absence of color appears to be due to fading. Snails living in full sun are usually white, while those living in the shade are often strongly colored. The brightest shells were found under rubbish in dumps and in culverts.

Normally this species climbs onto the shrubs in the summer, when the ground becomes too hot to stand on barefooted during the day, and they remain there until frost. But some colonies remain underground, coming out only at night after rains. Usually they are found on all the different kinds of plants which are growing in the area occupied by the colony. But some colonies are found only on the shrubs and not on the cactus, while other colonies are found on the cactus but not on the shrubs. One colony was found abundant on the fenceposts but not on the nearby plants. Colonies usually do not cover an area larger than an average city block. One will find a colony along a roadside and then drive for several miles through country where the soil and vegetation appear the same before finding another colony. Why they are not found more evenly distributed is one of many puzzling features of this species.

Bulimulus mooreanus (Pfeiffer).

The southern limit of the range of this species corresponds very closely with the northern limit of *B. alternatus.* There is very little overlap of the two ranges. Like *B. alternatus,* it estivates upon the bushes, and colonies are quite conspicuous. It differs from *B. dealbatus* in being larger and having a white, unvariegated shell.

Bulimulus mooreanus pecosensis Pilsbry & Ferriss.

This is a western subspecies of *B. mooreanus,* differing in having more rounded, more loosely coiled whorls. It is known from Sutton, Val Verde, Crockett, and Pecos Counties, and also was found in Indian kitchen middens in Coryell County, and in loess in Bexar County.

Bulimulus dealbatus (Say).

This species is common over most of southern Texas but is absent from Kleberg, Kenedy, Willacy, Cameron, and Hidalgo Counties. Westward it extends to Kinney County. Unlike *B. mooreanus* it does not remain above ground during the day, except during wet weather. As a result, it is not as frequently collected. It is quite common within the range of *B. mooreanus* in Bexar, Comal, Hays, and Guadalupe Counties, although reported

as absent from this area by Pilsbry (Land Mollusca of North America II, p. 13). Culverts are the best places to find living specimens during dry weather.

Bulimulus dealbatus ragsdalei Pilsbry.

This subspecies is found along the western edge of the range of *B. dealbatus.* In southern Texas, it is found in Val Verde, Crockett, Terrell, Pecos, and Brewster Counties. There was no intergradation in the specimens which I have seen and *ragsdalei* may prove to be a distinct species.

Hybridization in *Bulimulus:* Genetic barriers appear weak in our species of *Bulimulus,* and probably all will hybridize to some degree when living together. The principal barrier to hybridization appears to be ecological isolation. It is unusual for two species to live together.

Bulimulus schiedeanus × *Bulimulus alternatus.*

In a loess deposit near Terlingua, Brewster County, where both species were found fossil, one hybrid specimen was collected.

Bulimulus alternatus × *Bulimulus dealbatus.*

Several shells were found in places where the two species occurred together which were intermediate and which may be hybrids.

Bulimulus mooreanus × *Bulimulus dealbatus.*

In the upland, there is some subtile difference in habitat which keeps these two species apart. But in the floodplains of streams where the snails can be washed about by floods, hybrid colonies are frequent. They are especially abundant in the floodplain of the Colorado River. These hybrids are very beautiful shells, being large as in *B. mooreanus* but with more rounded whorls, white, variegated with brownish and translucent streaks. Occasionally a shell is found which is entirely translucent.

MUSSELS FROM THE ANGEL SITE, INDIANA

By PAUL W. PARMALEE
Illinois State Museum, Springfield

The deposition of fresh-water mussel shells (plus vertebrate remains) in midden heaps and refuse pits by prehistoric Indians has provided archaeologists with a knowledge of their food habits. To the zoologist, a sample of mollusks from a particular archaeological site may often serve as an index to the early environment of the local area once occupied. One of the most comprehensive

studies of this type was presented by Morrison (1942), while more recent ecological investigations of naiad remains from Illinois sites have been made by Matteson (1953; 1958) and Parmalee (1956). With the gradual acquisition and study of additional collections of these old shells, a more accurate picture may be formed of the early appearances of the streams and rivers in this midwest region and their naiad complex.

Excavation of the Angel Site, the largest Middle Mississippi site (1,100-1,550 A.D.?) in Indiana, began in 1939, and, with but few exceptions, summer field work has been continued through 1959. The site (now included in a 450 acre State Memorial) is located on the north bank of the Ohio River, approximately 2½ miles west of Newburgh, Vanderburgh County. Although the site was situated directly on the Ohio River, it was completely screened from the main channel by "Three Mile Island" (Black, 1944). There appears to have been a (spring-fed?) creek that surrounded the north, east, and west limits of the village; thus, with the Ohio River as the south border, the village and mounds were advantageously situated on an island that provided an immediately available source of game as well as natural protection.

Mr. Glenn A. Black, Newburgh, Indiana, has been in charge of the archaeological investigations at the Angel Site since they were initiated in 1939, and I would like to thank him, and the Indiana Historical Society, for permission to study the mollusk remains. I am also indebted to Dr. Henry van der Schalie, Curator of Mollusks, Museum of Zoology, University of Michigan, Ann Arbor, for identifying certain specimens. A total of 5,549 complete and/or fragmentary valves were identified, and the 31 species represented are listed in Table I.

Table I The species of Fresh-water Mussels Identified from the Angel Site, Vanderburgh County, Indiana. 1939-1958.

Species	No. of Valves
Pleurobema codatum, small niggerhead	2782
Fusconaia ebenus, niggerhead	1466
Elliptio dilatatus, spike	586
Cyclinonaias tuberculata, purple warty-back	424
Elliptio crassidens, elephant's ear	411
Obovaria retusa	160
Quadrula metanevra, monkey-face	113
Plethobasus cictricosus, sheep's-nose	105
Ligumia recta, black sand shell	82

Dysnomia perplexa	60
Amblema peruviana, blue-point	55
Lampsilis ovata, pocketbook	51
Obovaria subrotunda	40
Plagiola lineolata, butterfly	38
Plethobasus cyphyus, sheep's-nose	38
Cyprogenea irrorata	29
Obovaria olivaria, hickory-nut	16
Lampsilis orbiculata	14
Quadrula quadrula, maple-leaf	13
Dysnomia sampsoni	13
Megalonaias gigantea, washboard	12
Dysnomia flexuosa	12
Proptera alata, pink heel-splitter	6
Quadrula cylindrica, rabbit's-foot	5
Tritogonia verrucosa, buckhorn	4
Quadrula pustulosa, pimple-back	3
Dysnomia sulcata	3
Dysnomia triquetra	2
Obliquaria reflexa, three-horned warty-back	2
Lasmigona costata, fluted shell	2
Actinonaias carinata, mucket	2

In addition to the large quantity of mussels recovered at this site, a limited number (330) of gastropods were represented, primarily those of the genera *Mesodon, Triodopsis, Mesomphix, Pleurocera and Campeloma,* with shells of *Mesodon elevatus* comprising 33% of the total. All are local forms, and, since no definite caches or other evidence of collecting by the Indian were noted, these snails probably were not eaten. Unlike the quantity and variety of species found at Cahokia (Parmalee, 1958), a Middle Mississippi site in western Illinois that is contemporaneous with the Angel Site, marine mollusks were rare at this site.

Almost without exception, valves recovered at the Angel Site were, in proportion to the particular species, thick and heavy. The naiad complex represented here is one characteristic of a large-river environment, and the majority of the specimens certainly must have come from the Ohio River. Valves of *Pleurobema cordatum* were encountered in the largest numbers, and they amounted to 50% of the identified shells. Between 70 and 80% of these were referable to the form *P. c. pyramidatum,* a subspecies associated with rivers of large size. Numerous large specimens of the true *cordatum* and of *P. c. coccineum,* a subspecies that differs ecologically from the higher forms in that it normally inhabits smaller streams, were also present. However, these were

probably collected in the shoals (particularly in the section once known as "Scuffletown Bar") that formerly existed, before construction of navigation locks and dams, immediately above and below the site.

The second most numerous shell was the common niggerhead which is typically found in deep water; the abundance of this mussel, like other deep-water species such as *Elliptio crassidens, Obovaria retusa, Quadrula metanevra, Plethobasus* spp. and *Megalonaias gigantea,* may be interpreted as reflecting periods of unusually low water in the river. *Elliptio dilatatus* (10% of the total) occurs in shallows as well as at considerable depths, but judging from the size and thickness of the shells from this site, most specimens had inhabited moderately deep water. It is of interest to note that shells of *Obovaria retusa,* ". . . . the rarest of the three species of *Obovaria* in Indiana" (Goodrich and van der Schalie, 1944), were 10 times more numerous than the presently common *O. olivaria.*

Shells of 4 of the 5 species of *Quadrula* found in Indiana were recovered, but only those of *Q. metanevra* can be considered even moderately common. Remains of *Quadrula* were not uncommon in archaeological sites in southern Illinois (Parmalee, 1956) and, except for *Q. cylindrica,* the species are presently well represented in the lower Wabash and Ohio rivers. A similar status may be applied to *Amblema peruviana.* Considering the other species found by the Indian, the river environment should have been favorable for large beds of these forms as well. Probably mussels were collected in proportion to their abundance and availability, and, although certain species such as *A. peruviana* were locally abundant in the river, they were not common in those sections searched by the Indian. This may also explain the absence of *Fusconaia undata* from the Angel Site; the "pigtoe" is common in the lower Wabash and Ohio rivers today.

Several species considered rare in the rivers of southern Indiana today were apparently uncommon to rare in prehistoric times also, judging by the paucity of remains from archaeological sites. Fourteen valves of *Lampsilis orbiculata* were identified from the Angel Site material; although a widely distributed species in the larger rivers, it is seldom collected. *Dysnomia perplexa* was the most abundant representative of the genus found at Angel Site, although *D. triquetra* is presently the most common form oc-

curring in Indiana, but is least numerous at the site. The other 3 species *(sampsoni, sulcata, flexuosa)* totaled less than one % (28 valves), and today are considered as rare shells in the state (Goodrich and van der Schalie, 1944).

One of the most noteworthy finds in the mollusk sample from the Angel Site was the 105 valves of *Plethobasus cictricosus.* Goodrich and van der Schalie (op. cit.) state "This is a relatively rare species in Indiana. It has thus far been found only in the Wabash River." The quantity of valves recovered at this site indicates an established population of *P. cicatricosus* in this section of the Ohio River in prehistoric times, and suggests a more extensive range than is now known.

Only one head-water form, *Lasmigona costata,* was recovered, although it also occasionally is found in the larger portions of a river. The almost total predominance of deepwater species at the Angel Site is somewhat unusual, considering the difficulty that normally would be thought of in collecting them. Possibly the water level of the river normally became low enough in late summer and early fall to facilitate the gathering of such forms as *P. cordatum, F. ebenus* and *E. crassidens,* species usually found at considerable depths.

The physical nature of that section of Ohio River in which the Indians obtained mussels is reflected, to some degree, by the species represented. Although somewhat variable as to the kind of habitat required by each species, those found in the greatest number indicate a former gravel coarse-sand bottom with considerable river current. With the advent of pollution, silting, and the construction of navigation dams and locks, these formerly extensive mussel beds have been destroyed. The large numbers of fresh-water mussels, which inhabited that section of Ohio River adjacent to the Angel Site, provided the Indian with an abundant and easily obtainable source of food.

Literature cited

Black, Glenn A. 1944. Angel Site, Vanderburgh County, Indiana. Indiana Hist. Soc., Indianapolis, 521 pp.

Goodrich, Calvin, and Henry van der Schalie. 1944. A Revision of the Mollusca of Indiana. Amer. Mid. Nat., *32*(2):257-326.

Matteson, Max R. 1953. Fresh-water mussels Used by Illinoian Indians of the Hopewell Culture. Naut. *66*(4):130-138, and *67*(1):25-26.

—— 1958. Analysis of an environment as suggested by shells of

fresh-water mussels discarded by Indians of Illinois. Trans. Ill. Acad. Sci., *51*(3 & 4):8-13.
Morrison, J. P. E. 1942. Preliminary report on mollusks Found in the shell mounds of the Pickwick Landing basin in the Tennessee River valley. Smiths. Instit., Bur. Amer. Ethn., Bull. *129,* pp. 341-392.
Parmalee, Paul W. 1956. A comparison of past and present populations of fresh-water mussels in southern Illinois. Trans. Ill. Acad. Sci., *49:*184-192.
—— 1958. Marine shells of Illinois Indian sites. Naut. *71*(4):132-139.

NEW PALLIFERA (PANCALYPTUS) FROM ARIZONA

By CHARLES D. MILES and ALBERT R. MEAD

During the summer of 1910, Henry A. Pilsbry, James H. Ferriss, and L. E. Daniels collected land snails in the Santa Rita Mountains, located 40 miles south of Tucson, in southern Arizona. An account of this trip appeared in 1915 (Pilsbry and Ferriss), in which their route was traced starting at the western base of the range in Agua Caliente Canyon, then up and over the summit north of Mt. Wrightson (Old Baldy) and down the eastern slope. A list of species of snails collected, with their localities, appeared in this paper. Although slugs were not mentioned in the 1915 report, Pilsbry (1917) later stated that several slugs had been found during their 1910 trip into the Santa Ritas and three of the slugs were assigned to the genus *Philomycus.* He noted that this was a new record for Arizona and that this locality was more than 1,000 miles southwest of any record for the genus in the United States. Pilsbry named the slug *Philomycus (Pallifera) arizonensis.*

In 1948, Pilsbry stated that the slugs collected in 1910 had been subsequently lost or misplaced and that "in the absence of a sufficient description, it can hardly claim a place among known species" (Pilsbry, 1948:770). The only description of *P. arizonensis* is as follows: "Color, above bister, below snuff brown (in alcohol). Jaw with few ribs. It is 20 mm. long, the sole 1.8 mm. wide. Ribs of the jaw extremely weak" *(loc. cit.).* The type locality is Camperel Canyon, on the eastern slope of the Santa Rita Mountains, at an elevation of 6800 feet.

In August, 1957, Miles found several slugs belonging to the genus *Pallifera* in Madera Canyon, Santa Rita Mountains, at an elevation of 6400 feet. This site is near the type locality for

Philomycus arizonensis Pilsbry, although situated on the west side of Mt. Wrightson, rather than on the east. Probably these slugs represent Pilsbry's lost species. Additional specimens have been collected since then. An anatomical examination revealed the fact that this species of *Pallifera* must be assigned to the subgenus *Pancalyptus,* which Pilsbry (1948) established to embrace *Pallifera costaricensis alticola* H. B. Baker and probably "all Philomycidae in tropical America, from Mexico to Columbia" *(op. cit.,* p. 750). This subgenus differs from the typical eastern North American *Pallifera* in that the duct of the spermatheca is not enlarged and the free oviduct is very short.

During the several years extending from 1951 until the date of the Madera Canyon discovery (1957), Mead had collected a total of 10 slugs belonging to *Pallifera* from two localities in the Santa Catalina Mountains, 50 miles north of the Santa Ritas. Additional specimens have been collected recently and a comparison made with the Santa Rita slugs. Although the internal anatomy of specimens from the two ranges seem indistinguishable, there are consistent external differences that warrant subspecific treatment.

The question of whether the slugs inhabiting Madera Canyon are conspecific with Pilsbry's *Philomycus arizonensis* may never be answered, unless the lost type material comes to light. We are tempted to conclude in the affirmative, but the possibility that two or more species of *Pallifera* exist in the Santa Ritas cannot be discounted. Consequently, in the absence of type material and because of what Pilsbry himself admitted was an inadequate description, we consider *Philomycus (Pallifera) arizonensis* Pilsbry a *nomen dubium,* and accordingly, here describe the slug recently found inhabiting the Santa Catalina and Santa Rita mountains as a new species.

Pallifera (Pancalyptus) pilsbryi, new species.

Pl. 5 (Jan., 1961)

Philomycus (Pallifera) arizonensis Pilsbry, 1917, *Nautilus, 30:*119; 1948, Mon. Land Moll. North America, 2(2):770. [?]

Type Locality: Bear Wallow, Santa Catalina Mountains, Pima Co., Arizona. Elevation ca. 7600 feet. Beneath logs and in decayed logs. This slug has also been collected in Marshall Gulch at 7800 feet in the same range. *Type lot:* Holotype (dissected) and one paratype (undissected) collected 25 July, 1960, deposited in the California Academy of Sciences; one paratype col-

lected 23 October, 1955, deposited Acad. Nat. Sci. of Philadelphia; and two paratypes (dissected) have been retained in the Museum of Invertebrate Zoology at the University of Arizona.

Living Animal: Up to 30 mm. in length, although most specimens have ranged from 15 to 19 mm. when crawling; 2.5 mm. wide in the largest specimen. Sole considerably narrower, 0.8 mm. wide in a specimen whose width was 2 mm. when crawling. Mantle covers the entire body except the posterior tip of foot. The head is usually not visible when the animal is active, only the tentacles protrude from beneath the mantle. Color is brown with a faint grayish cast. A very fine, light gray stippling is present dorsally and laterally on the anterior (mainly) and posterior portions of the mantle and may be present in small clusters or in single dots anywhere along the mantle. This fine stippling varies with the individual, but is always present. Tentacles dark gray to black, immaculate. Color of the sole is light gray, possessing rust-colored pigmentation on the surface from the anterior tip posteriorly to about the level of the pneumostome; this rust-colored pigmentation then extends posteriorly only along the margins of the sole of the entire length of the animal, becoming fainter posteriorly. The pneumostome appears as a whitish groove slanting dorsoposteriad, situated about 2 mm. from the anterior end of the mantle on the right side.

Genitalia: Vagina and genital atrium are light yellow in color, the walls of both composed of glandular alveoli which differ strikingly from other portions of the genitalia. The penis, which lacks a verge, is narrower than the vagina and is swollen distally; a muscular sheath encloses the thinner walled, basal third of this organ, but not the vas deferens. The penis and sheath constrict somewhat near the genital atrium. Ovotestis dark gray, partly embedded in the digestive gland on the right side midway the length of the animal. Hermaphroditic duct cream colored, immaculate, sinuous but not convoluted. Spermatheca light gray, oval, situated between the anterior portions of stomach and digestive gland, attached to the uterus by connective tissue. Prostate white, relatively large. Duct of the spermatheca of equal diameter throughout its length; its diameter is about equal to that of the vas deferens and is considerably smaller in diameter than either the vagina or free oviduct. The free oviduct is very short.

Jaw: The color is golden brown (in fresh material) and possesses the peculiar chitinization of the retractor, (simulating the condition in the Succineidae) mentioned by Baker (1930) in connection with *Pallifera costaricensis alticola* and *P. c. crosseana.* The ribs are poorly developed; 4 and 5 have been seen. The jaw of one specimen lacked ribs. Fine longitudinal striations are evident on the chitinized portion of the retractor.

That the affinities of this species are with the subgenus

Pancalyptus is evident from the very slender spermathecal duct and the short free oviduct. Its nearest known relative is *P. costaricensis alticola* H. B. Baker, from which it differs in its considerably smaller size, in color and in lack of definite mantle markings. *P. c. alticola* possesses a light golden dorsum which bears jet-black lateral and mid-dorsal stripes.

Pallifera pilsbryi santaritana, new subspecies.

Type locality: Madera Canyon, Santa Rita Mountains, Santa Cruz Co., Arizona. Elevation ca. 6400 feet. Beneath rocks and logs on the west side of the canyon about 1.5 miles up the trail to Mt. Wrightson. *Type lot:* Holotype (dissected) collected 2 August, 1960, and one paratype (undissected) collected 13 July, 1960, deposited in the California Academy of Sciences; and one paratype (dissected) collected 13 July, 1960, has been retained in the Museum of Invertebrate Zoology at the University of Arizona.

This slug differs from *P. pilsbryi pilsbryi* of the Santa Catalinas in two consistent characteristics of external morphology. In life, the color is dark gray, with little or no trace of brown which characterizes the nominate subspecies. Furthermore, the rust-colored pigmentation on the margins of the sole extends posteriorly only about one-third the length of the animal in *P. p. santaritana,* while in the nominate subspecies this pigmentation extends the entire length. By using living animals from both mountain ranges, these two subspecies may be easily distinguished. There appears to be no differences in the internal anatomy of the two subspecies.

Literature cited

Baker, H. Burrington. 1930. Mexican Mollusks collected for Dr. Bryant Walker in 1926. Pt. 2. Occas. Pap. Mus. Zool., Univ. Michigan, no. 220, pp. 1-45, 5 pls.

Pilsbry, Henry A. 1917. *Philomycus* in Arizona. Naut. *30*(10):119.

—— 1948. Land Mollusca of North America. Mon. 3, Acad. Nat. Sci. Philadelphia, *2*(2), xlvii + 592 pp., 585 figs.

—— and James H. Ferriss. 1915. Mollusca of the Southwestern States, VII.—— The Dragoons, Mule, Santa Rita, Baboquivari, and Tucson Ranges, Arizona. —— Proc. Acad. Nat. Sci., Philadelphia, *67*:363-418. 8 pls., 8 figs.

TWENTY-SIXTH ANNUAL MEETING OF THE AMERICAN MALACOLOGICAL UNION

The A.M.U. met at Montreal, Canada, from August 9 to 12, 1960. The principal meetings were held in the auditorium of the Redpath Museum of McGill University, at the northern base of

the mount which gives the city its name. In all, 96 signed the register, in addition to our hosts. Welcome to Montreal was given by Alice J. Turnham, Director of the McGill University Museums, and President Katherine Van Winkle Palmer responded for the A.M.U. This was followed by memorial tributes to Philip P. Carpenter, from the California Academy of Sciences (read by Albert R. Mead), from the British Museum (read by Ruth D. Turner) and from the Smithsonian Institution and U. S. National Museum (read by Harald A. Rehder).

Mrs. Palmer presided charmingly over the following papers and talks:

"Resumé of life of Philip P. Carpenter and brief description of the Redpath Museum shell collections," Vincent Condé "Small beginnings," Adlai B. Wheel, Sr. "Natural history museums of Europe," Ruth D. Turner. "Behaviour studies an aid to taxonomy as exemplified by *Limax poirieri*," Edward J. Karlin. "Paper chromatography in systematic research," John B. Burch. "Problems of monographing a genus," S. C. Hollister. "Some South African ischnochitons," Virginia Orr. "The bivalve gastropod and the opisthobranchs," William J. Clench. "Notes on the bivalved univalves," Joseph P. E. Morrison. "Structure, zoogeography, and evolution of the abyssal mollusk fauna," Arthur H. Clarke, Jr. "Shallow-water mollusks of eastern Canada," E. L. Bousfield. "Shell collecting in the Netherlands Antilles," H. E. Coomans. "A soil protozoan infecting land snails," John B. Burch. (By title: "Chemoreception in fresh-water pulmonate snails," Edward H. Michelson.) "Evolution of non-marine mollusks in the Cretaceous and Tertiary of western Canada," L. S. Russell. "Changes in the gastropod populations in the Salt Fork of the Big Vermilion River in Illinois, 1918-1959," Ralph W. Dexter. "The molluscan fauna of pluvial Lake Bonneville," Ernest J. Roscoe. "Rediscovery of Pilsbry's *Philomycus (Pallifera) arizonensis*," Charles D. Miles and Albert R. Mead. "Desert, jungle and laboratory — Activities of a museum malacologist," Alan Solem. "Remarks concerning the benefits of systematic and repetitive collecting from navigation buoys," Arthur S. Merrill. "How I collect Sphaeriidae," H. B. Herrington. "Heilprin's Caloosahatchee Horizon shells," Lula B. Siekman. "Collecting in Cuba," Vincent Condé. "Thailand experiences," Albert R. Mead.

At the Thursday afternoon business meeting, where Dr. Ruth D. Turner acted as temporary secretary,[1] the following were elected officers for 1960-61:

---

1 Due to a fatal sickness in her family, Margaret C. Teskey was unable to come to Montreal and any errors in this account are my mistakes. — H.B.B.

President, Thomas E. Pulley. Vice-president, William K. Emerson. Second Vice-president, Chairman-incumbent, A.M.U. Pacific Division, Howard R. Hill. Secretary-Treasurer, Margaret C. Teskey. Publications Editor, George M. Moore. Councillors-at-Large, Dorothea Franzen, Juan Parodiz, Gilbert Voss and Anthony D'Attilio. Announcement was made that the council had accepted the invitation of the U. S. National Museum to hold the 1961 meeting in Washington, D. C., that Dr. Fritz Haas had been added to the list of Honorary Life Members, and that S. Stillman Berry had been elevated to Honorary Life President.

Other features of the meeting were: The informal symposium on Tuesday evening, presided over by Arthur H. Clarke, Jr., and assisted by Anthony D'Attilio and members of the New York Shell Club. Movies of Australian reef marine life, given Wednesday evening at the Université de Montréal, and introduced by Dr. Edouard Pagé, Director of its Department of Biology. Movies on "Between the tides," courtesy of McGill University Museums. And, an informal visit to the Arctic Institute of North America.

Thursday evening, following a delightful cocktail party, given at the Royal Victoria Dormitory, by the McGill University Museums, the annual banquet was held at the Hélène de Champlain, L'ile Ste. Hélène. After short talks by Col. P. D. Baird and other members of the staffs of the McGill University Museums and Biology Department, and of the Université de Montréal Biology Department, the principal speaker, Dr. Loris S. Russell, National Museum of Canada, gave an interesting address on "Montreal — Natural and unnatural history."

Friday morning, automobiles and a bus transported those making the field trip to the McGill University Preserve of Mont St. Hilaire, in the Monteregian Hills. Col. P. D. Baird was the host; and box lunches were eaten along Lac Hertel near Gault Lodge. Land and fresh-water collecting was enjoyed. On the way, a stop was made at nearby gravel-pits, where fossil bivalves and barnacles from the Post-Glacial Champlain Sea were numerous. The late afternoon return to the Royal Victoria Dormitory, where most visitors had excellent rooms and enjoyed meals at the fine cafeteria, rang the curtain down on the twenty-sixth annual meeting. — MARGARET C. TESKEY, Secretary-Treasurer.

NOTES AND NEWS

Department of Living Invertebrates re-established at the American Museum—The American Museum of Natural History recently announced the re-establishment of the Department of Living Invertebrates with Dr. William K. Emerson as chairman and malacologist. The department had been de-activated since World War II. The new department is responsible for the recent invertebrates, exclusive of insects, and includes 7 permanent members. Working on mollusks, in addition to Dr. Emerson, are Dr. H. E. Coomans, Research Fellow and William E. Old, Jr., technical assistant. Dr. William J. Clench (Harvard University) is a Research Associate in Malacology.

Dr. Coomans, with the able assistance of Mr. Old, is rearranging the molluscan collection of more than 80,000 catalogued lots according to a modern classification. The work of Dr. Coomans, who studied under Mrs. W. S. S. van der Feen-van Benthem Jutting at the Amsterdam Museum and formerly was associated with the Caribbean Marine Biological Institute at Curacao, is being supported by a grant from the National Science Foundation. Bill Old, an avid student of conchology, will undertake a newly organized program of exchanges. — R.T.A.

Conus mus Bruguiére, 1792, should be added to the fauna of the eastern Pacific. Specimens of this well known Caribbean species have been received on numerous occasions from Panama Bay mixed with *Conus gladiator* Broderip, 1833, but I have been reluctant to confirm the range extension until I had definite and dependable collecting data. Mr. Harris P. Dawson, Jr., collected a number of specimens in March, 1960, from "Panama Bay, under rocks at lowest tide off Veracruz village beach." These shells are identical with the specimens from the Caribbean. I am indebted to Mr. Anthony D'Attilio for his advice on comparison of the two species.

The coloring of *Conus mus* consists of a brown shading over a blue gray ground color; the spiral whorls have 4 incised striae. The coloring of *Conus gladiator* is that of a white shell with brown shading, and the spiral whorls have but two strong spiral chords. There is also a somewhat greater convexity of the body whorl on *Conus mus*.

The taxonomy of this species is, as might be expected, a matter of mild controversy. Dr. William J. Clench in "Johnsonia," no. 6, p. 7, placed *Conus mus* Bruguiere, 1792 (or Hwass if you prefer) in the synonymy of *Conus citrinus* Gmelin, 1791. This is no doubt technically correct, but some of us are reluctant to abandon the name *Conus mus,* a name under which the species has been known for generations. — John Q. Burch, 4206 Halldale Ave., Los Angeles 62.

Cepaea nemoralis (Linne) from Newport, Rhode Island. — A small colony of this species has been found recently (1959) in an abandoned quarry near the Rogers High School in Newport. The colony is small but it might well persist in such a locality. I am indebted to Mr. J. J. Mahoney Jr. for this record, which is the first from Rhode Island as far as can be determined. — William J. Clench.

Beach drift land snails from southern Texas (exclusive of Polygyridae) —The Polygyridae of the Texas beach drift were treated in a previous paper (Pilsbry, H. A. & L. Hubricht, 1956. Naut. *69*:93-96, Pl. 5). The present paper lists the rest of the land snails which were collected there. Dr. Joseph C. Bequaert identified most of the Mexican species.

As in the first paper, the abbreviations BC, PIa, and PIb are used for the three localities, followed by the number of specimens collected.

Thysanophora horni (Gabb), BC-5, PIa-1.
Bulimulus alternatus mariae (Albers), BC-3, PIa-3, PIb-1.
Holospira roemeri (Pfr.), BC-8, PIa-1, PIb-1.
Holospira montivaga Pils., PIa-1.
Lamellaxis mexicanus (Pfr.), BC-5, PIa-1, PIb-1.
Synopeas beckianum (Pfr.), PIa-12, PIb-2.
Cecilioides acicula (Müll.), PIa-1.
Euconulus chersinus trochulus (Reinh.), BC-5.
Guppya gundlachi (Pfr.), BC-3.
Retinella indentata paucilirata (Morelet), PIb-1.
Hawaiia minuscula (Binn.), BC-10, PIb-3.
Anguispira strongylodes (Pfr.) (= A. *crassa* Walker), PIb-1.
Helicodiscus parellelus (Say), PIa-2.
Helicodiscus eigenmanni Pils., BC-2.
Helicodiscus singleyanus (Pils.), BC-2.
Succinea luteola Gould, PIb-5. This species has a much too open aperature to drift in the sea. They were probably native to

Padre Island, although none was found alive.

Strobilops labyrinthica (Say), PIa-1, PIb-3.

S. texasiana (Pilsbry & Ferriss), BC-5, PIa-1, PIb-4.

Gastrocopta contracta (Say), BC-75, PIa-8, PIb-4.

G. tappaniana (C. B. Adams), BC-17, PIb-1.

G. riograndensis (Pilsbry & Vanatta), BC-100.

G. cristata (Pilsbry & Vanatta), BC-50, PIa-1.

G. pellucida hordeacella (Pilsbry), BC-20, PIb-1.

Pupoides albilabris (C. B. Adams), BC-25, PIa-1, Pib-1.

Helicina chrysocheila Binney, BC-5, PIa-8, Pib-15. The record for this species from near the mouth of the Rio Grande, Texas (Pilsbry, H. A. 1948. Land Mollusca of North America. vol. II, page 1081) is based on two worn dead shells (William Lloyd, U.S.N.M. 123167) which have the appearance of beach drift shells.

H. orbiculata (Say) and *H. o. tropica* Pfr., BC, PIa, PIb. These two forms occurred in about equal numbers with numerous intergrades. Next to *Polygyra texasiana* (Moricand) they were the most abundant shells.

H. fragilis elata shuttleworth, BC-6, PIa-32, PIb-52.

Lucidella lirata (Pfr.), BC-1, Pla-11, PIb-1.

Lucidella sp. ?, PIa-1. This shell is a little larger than that of *L. lirata* (Diam. 4.5, Ht. 3 mm.) with strong radial ribs rather than spiral ribs. The aperture is somewhat expanded but is not thickened.—Leslie Hubricht.

Hendersonia occulta fossil in Mississippi.—*Hendersonia occulta* (Say) was found fossil in the loess, near the junction of US-49W and US-49E, 1 mile east of Yazoo City, Yazoo Co., Mississippi. This is a substantial extension of the range of this species to the south. It was not previously known, living or fossil, south of Tennessee. Associated with it in the loess were the following species: *Stenotrema barbatum* (Clapp), *Stenotrema stenotrema* (Pfr.), *Stenotrema leai aliceae* (Pils.), *Mesodon zaletus* (Binn.), *Triodopsis vulgata* Pils., *Triodopsis denotata* (Fér.), *Triodopsis fosteri* (F. C. Baker), *Allogona profunda* (Say), *Haplotrema concavum* (Say), *Ventridens ligerus* (Say), *Zonitoides arboreus* (Say), *Anguispira alternata* (Say), *Discus patulus* (Desh.), *Succinea ovalis* Say, *Strobilops labyrinthica* (Say), *Gastrocopta armifera* (Say), *and Pomaitopsis lapidaria* (Say).—Leslie Hubricht.

Bradybaena similaris (Fer.) in Mississippi and Alabama.—The author recently found this introduced snail abundant under old ties along the railroad at Laurel, Jones Co., Mississippi, and

in a garden in Livingston, Sumter Co., Alabama. The species was identified by Dr. Fritz Haas. — Leslie Hubricht.

Some mollusks from Manitoba, Canada. — The 9th International Botanical Congress that was held in Canada during August, 1959, offered excursions to many parts of Canada. Shells were collected from Winnipeg to Churchill along the Canadian Pacific Railroad tracks from August 7-14.

For a description of the climate and topography of the Churchill region, reference is made to "Inland Mollusks from Hudson Bay, Manitoba" by Wm. J. Wayne, Naut. *72*:90-95, 1959.

Additions to Mr. Wayne's list of mollusks found about Churchill are *Vertigo modesta, Lymnaea arctica, Gyraulus deflectus,* and *Aplexa hypnorum.*

The only stop of considerable length during the journey was at Wabowden, Manitoba. This town lies in a well forested area, abounding in lakes and bogs.

Euconulus fulvus, Retinella electrina, Zonitoides arboreus, Discus cronkhitei, and *Cionella lubrica* were found in a softwood grove at the edge of Wabowden. On the stems of *Typha* and in the *Sphagnum* moss and mud of a bog, *Lymnaea palustris, L. stagnalis, Gyraulus circumstriatus, G. deflectus, Armiger crista, Promenetus umbilicatellus, Aplexa hypnorum, Valvata lewisi* and *Pisidium casertanum* were collected in considerable numbers. — Dorothy E. Beetle.

Additional molluscan records for Albany County, Wyoming. —Mollusks previously unreported for Albany County, Wyoming, are as follows:

Microphysula ingersolli (55-535), Pole Mountain, South Fork Pole Creek, aspen grove.

Punctum minutissimum (53-88), same locality.

Discus shimeki cockerelli (55-521), Fence Creek at base of Sheep Mountain, aspen grove.

Retinella electrina (56-281), Tie Siding, Texas Creek, willow thicket.

Oxyloma decampi gouldi (56-120), same locality.

Succinea avara (57-384), Laramie Mountains, aspen grove below Elephant Head.

Galba obrussa (56-109), Medicine Bow Mountains, temporary pond below Lewis Lake.

Gyraulus circumstriatus (55-529), Pole Mountain, Middle Fork Pole, Creek, swampy area.

Gyraulus parvus. Dr. Dwight W. Taylor has indicated the Wyoming material previously recorded as *G. vermicularis* and *G. similaris* should be included in the species, *G. parvus*.

Physai anatina (55-505), Foxpark, Fox Creek at the railroad tracks.

Physai smithiana (55-501), Medicine Bow Mountains, Lake Creek at Lake Creek Resort, muddy pond.

Physa integra (50-229), Dale Creek at road from Hermosa to Sherman.

Valvata lewisi, substitute for *V. lewisi helicoidea.*

Sphaerium lacustre ryckholti (56-132), Medicine Bow Mountains, Gramm, beaver pond. — DOROTHY E. BEETLE.

PUBLICATIONS RECEIVED, 1959

Pages in *italics* include new taxons

Carriker, Melbourne Romaine. Comparative functional morphology of the drilling mechanism in *Urosalpinx* and *Eupleura*. 25th Internat. Cong. Zool., Sect. 4, paper 27, 3 pp. The role of physical and biological factors in the culture of *Crassostrea* and *Mercenaria* in a salt-water pond. Ecolog. Monogr. *23:*219-266, 41 figs.

Cintra, Horacio & H. de Souza Lopes. Sur la forme et quelques caracteristiques mathematiques des coquilles des gastéropodes. Rev. Brasil. Biol. *12:*185-200, 20 figs. 1952.

Clarke, Arthur H., Jr. & Clifford O. Berg. The freshwater mussels of central New York, etc. Cornell Univ. Agric. Exp. Sta., Mem. *367:*79 pp., 7 pls. & map.

Dodge, Henry. A historical review of the mollusks of Linnaeus. Part 7, Certain species of the genus *Turbo,* etc. Bull. Amer. Mus. Nat. Hist. *118:*207-258. $1.00.

Drake, Robert J. Nonmarine molluscan remains from recent sediments in Matty Canyon, Pima County, Arizona. Bull. S. Calif. Acad. Sci. *58:*146-154, 2 figs.

Forcart, Lothar. Die systematische Stellung von *Clausilia strobeli.* Die palaearktischen Arten des Genus *Columella.* Verh. Naturf. Ges. Basel *69:*167-168. *70:*7-18, 3 figs.

Grau, Gilbert. Pectinidae of the eastern Pacific. Allan Hancock Pac. Exped. *23:308* pp., 57 pls. $4.50. Univ. South. Calif. Press, Los Angeles.

Haas, Fritz. Inland mollusks from Venezuela, southern Brazil, and Peru. Fieldiana, Zool. *39:363-371,* figs. 60-64.

Leonard, A. Byron. Handbook of gastropods in Kansas. Univ. Kas. Mus. Nat. Hist., Misc. Publ. *20:*224 pp., 11 pls. & 87 figs.

Medina, Nieves Pereira de. "Syrnolopsinae." Neotropica *5:51-55,* fig.

Melville, R. V. Proposed further use of the plenary powers in the case of the generic name *Pleurocera* Rafinesque, 1818 (Class Gastropoda). Bull. Zool. Nomencl. *17:*170-174.

THE NAUTILUS

Vol. 74 January, 1961 No. 3

REVIEW OF PYRAMIDELLID HOSTS, WITH NOTES ON AN ODOSTOMIA PARASITIC ON A CHITON

By ROBERT ROBERTSON and VIRGINIA ORR
Academy of Natural Sciences of Philadelphia

Pyramidellids are now well known as ectoparasites on polychaetes, gastropods and pelecypods. These opisthobranchs also feed on or occur with several other kinds of invertebrates, most of which are sessile or sedentary. This paper is a review of what is known of the associations of pyramidellids with invertebrates other than polychaetes, gastropods and pelecypods. In addition, we include original observations on a South African pyramidellid which occurs on a chiton, presumably as a parasite.

The degree of host specificity of several pyramidellids is low. Some species perhaps are not parasites, for they occur alive where no hosts seem to be available for them. Sanders (1958) considered an unidentified species of *Turbonilla* which lives in Buzzards Bay, Massachusetts, to be a deposit feeder because it is remarkably abundant relative to the other invertebrates with which it occurs. However, no direct observations on feeding were made and the possibility that this *Turbonilla* is a non-specific parasite was not taken into account.

Even the discovery of a pyramidellid "on" or "with" another invertebrate does not mean necessarily that the invertebrate in question is host to the pyramidellid. Pyramidellids which are found on the backs of *Haliotis* shells probably parasitize the serpulids and other polychaetes which are present there rather than the gastropod itself. The only reliable records of parasitic relationships are those in which a pyramidellid has been seen to feed. The present review should serve as a guide for future field and laboratory studies. No doubt other kinds of hosts remain to be discovered.

The names adopted for the European pyramidellids which are mentioned in this paper are those used by Winckworth (1932) in his list of British marine mollusks.

Dr. Gunnar Thorson (Marine Biological Laboratory, Grönnehave, Helsingör, Denmark) has kindly allowed us to include in this paper some of the unpublished observations which he has made on pyramidellids along the southwest coast of Sweden and in eastern Denmark.

Sponges. According to Fretter & Graham (1949) sponge spicules were found in the gut of *Odostomia (Odostomia) plicata* (Montagu) at Plymouth, England. They suggest that this species, which is found in association with a polychaete, may feed on a sponge.

Coelenterates. *Menestho (Liostomia) clavula* (Lovén) was discovered off the southwest coast of Sweden with *Pennatula,* a sea pen (Lovén, 1846). At Plymouth, *Turbonilla (Pyrgisculus) jeffreysii* (Forbes & Hanley) [possibly a subspecies of *T. scalaris* (Philippi)] apparently feeds on a coelenterate, probably *Halecium,* a hydroid (Fretter & Graham, 1949).

Sipunculids. The specimens described and named *"Odontotomia" (Auristomia) perezi* by Dautzenberg & Fischer (1925) were found in association with the sipunculid *Phascolion strombi* (Montagu) in the empty shells of *Turritella* and *Nassarius* on the coast of Brittany, France. Thorson believes (*in litt.,* February 22, 1960) that *O. perezi* is a synonym of *Menestho (Evalea) diaphana* (Jeffreys). This species parasitizes *Phascolion strombi* in the Oeresund (between Denmark and Sweden). Thorson has also found an egg mass of *Eulimella (Ebalina) nitidissima* (Montagu) inside the empty shell of a *Turritella* inhabited by *Phascolion* in the northwest Kattegat, indicating that *E. nitidissima* may also parasitize *P. strombi.*

Polychaetes, gastropods and pelecypods. These are the usual hosts of pyramidellids.

Crustacea. *Odostomia plicata* was seen by Fretter & Graham (1949) to thrust its proboscis onto the antennae of amphipods at Plymouth (see above under sponges). This behavior may well have been accidental.

Echinoderms. Two families of prosobranch gastropods, the Eulimidae (or "Melanellidae") and the Stiliferidae occur as parasites on and in echinoderms. Some eulimids appear to be free-living. The pyramidellids were grouped near the eulimids and stiliferids in the "Stirps" Aglossa by Thiele. Thorson and Fretter & Graham have shown since that pyramidellids are opisthobranchs and are not closely related to these other two

families (see, however, Fretter, 1955). Pyramidellids are predominantly non-echinoderm parasites. However, Macnae reports (1958) a pyramidellid (probably *Pyramidella dolabrata* (Linnaeus); see below under hemichordates) with *Echinodiscus,* a sand dollar, in Mozambique. (The "?*Odostomia* sp." parasitic on *Holothuria* is probably not a pyramidellid.) Furthermore, Thorson states *(in litt.)* that a small pyramidellid occurs off the southwest coast of Sweden around the anus of the heart urchin *Spatangus purpureus* Müller. This species is identified tentatively by Thorson as *Menestho clavula* (see above under coelenterates).

Hemichordates. *"Pyramidella" [Otopleura] mitralis* (A. Adams) and *"Obeliscus dolobratus" [Pyramidella dolabrata]* live with *Ptychodera,* an enteropneust, in Mozambique (Macnae, 1958). (The name *mitralis* appears to have been used for *dolabrata* and vice versa.)

Tunicates. *"Odostomia" impressa* (Say) [not a true *Odostomia*] has been seen by Allen (1958) to feed on *Molgula,* a simple ascidian (sea squirt) in Chesapeake Bay, Maryland.

Chitons

In 1899 E. A. Smith described and named *Odostomia chitonicola* from South Africa. This species was found by Mr. Henry Burnup at "Unkomaas" [Umkomaas], Natal, on *"Chiton fossus"* [*Dinoplax fossus* Sykes]. (According to Ashby (1928) this chiton is a form of *Dinoplax gigas* (Gmelin).) No other mention of a pyramidellid occuring on a chiton has been found by us. In 1932 Turton reported small, worn specimens of *Odostomia chitonicola* from Port Alfred, 330 miles southwest of Umkomaas. Presumably these were in beach drift.

Odostomia chitonicola has been found by us on some specimens of *Dinoplax gigas* collected by Orr at Port Edward, Natal, 67 miles south of the type locality of *O. chitonicola*. Unfortunately, the gastropods were not discovered until after they and the chitons had been killed in alcohol and dried. Nevertheless, numerous specimens remained on one of the chitons.

The *Dinoplax* were collected from sand-drifted rock crevices about one foot below low tide mark. Orr's field notes mention that there were frequently as many as 4 of these large chitons (3 or more inches in length) partially overlapping one another. The sea was muddy at the time the chitons were collected (ap-

parently because of the entry of a river in flood into the sea about two miles to the south) but was not brackish.

The most heavily infested *Dinoplax* is 83 mm. long (slightly curled) and is the largest of 6 specimens (A.N.S.P. no. 218330). All the odostomias (A.N.S.P. no. 247768) are on the dorsal surface of the girdle, among the spinelets. They resemble the siliceous sand grains which are also present. We estimate that about 180 specimens of *O. chitonicola* remained on the girdle of this one *Dinoplax* after it was placed in alcohol and subsequently dried. They are located all around the girdle, some near the edge, others near the shell valves. A few are on the girdle between the lateral areas of the valves. Nearly all are placed with the apertures of the shells adjacent to the girdle proper near the bases of the spinelets, with the apices of the shells projecting upwards. The odostomias tend to occur in clusters of 3 to 6 individuals and there are more on the anterior half of the chiton than on the posterior—perhaps because the girdle is slightly more abraded posteriorly than anteriorly (see below). Most of the shells are glossy and transparent; a few are chalky and opaque. Evidently the latter are the shells of individuals which had died before the chiton was collected and had remained among the spinules with the sand grains.

About 15 juveniles of *O. chitonicola* were found on the girdle of another of the chitons (63 mm. long), at the anterior end, and 2 more on a third (46 mm. long), on the left side, near the junctions of the first and second, and third and fourth valves. There were no odostomias on the remaining 3 chitons (66, 57 and 38 mm. long).

The scarcity or absence of *O. chitonicola* on all but one of the chitons is noteworthy in view of the fact that all 6 chitons were collected within a few feet of each other. Before we were able to count them, some of the odostomias probably dropped off the chitons. The spinules on the girdle of large specimens of *Dinoplax gigas* are sometimes worn off. There would be little protection for the *Odostomia* on such a girdle. However, such is not the case with any of the specimens from Port Edward and there is no reason to believe that a disproportionate number of odostomias was lost from any of the six chitons.

Although the case remains to be proved, we believe that *O.*

chitonicola does in fact parasitize *Dinoplax gigas,* probably piercing the girdle and sucking fluids from it. The abundance of the *Odostomia* and the uniform position in which most of the specimens were found makes the inference reasonable.

The type specimen of *O. chitonicola* is 2 mm. long. The largest specimen found by us (Pl. 6, figs. 8, 9) is only 1.4 mm. long. Nearly all the shells are young and some are extremely small (fig. 1). The infested chitons were collected at Port Edward on March 5, 1955, showing that this *Odostomia* reproduces in the (southern) summer.

Exteriorly, the apex of the adult shell (figs. 6, 7) bears no trace of the heterostrophic protoconch characteristic of many but not all pyramidellids. Thorson (1946) has shown that all pyramidellids with heterostrophic protoconchs probably have larvae with a long pelagic stage, while those lacking such a protoconch (like *O. chitonicola*) have non-pelagic larvae or larvae with a very short pelagic stage. Non-pelagic development of the larvae of *O. chitonicola* would account for the occurrence of most of the specimens from Port Edward on the single *Dinoplax*. Non-pelagic development would also account for the presence of the extremely small larval shells on the chiton. Furthermore, our observations suggest that these larvae are, like the adult, fairly sedentary and probably start feeding parasitically at an early age.

The growth of the larval shell and its position relative to the adult shell has not been studied adequately in pyramidellids with non-pelagic development. Despite many statements in the literature to the contrary, pyramidellids never have truly sinistral, larval shells. Heterostrophic protoconchs appear to be sinistral but in fact are dextral and hyperstrophic (or "ultradextral"). Coiling is invariably dextral throughout life. We figure larval shells of *O. chitonicola* of two ages (Pl. 6, figs. 1-5). They show a trace of hyperstrophic coiling although regular orthostrophic coiling starts during growth of the first whorl. The youngest part of the shell is swollen and sac-like and, in the single whorl stage, projects towards the umbilical region (fig. 1).[1] We suggest that this structure of the larval shell of *O. chitonicola* has

[1] A larval shell of a pyramidellid figured by Rasmussen (1951) and thought by him to be sinistral was slightly tilted and upside down.

resulted from great reduction of a several whorled, hyperstrophic (i. e. heterostrophic) protoconch in the course of evolution. This may be true of all pyramidellids which have short or non-pelagic larval development.

The type species of *Odostomia, O. plicata* (Montagu), and 4 other European species grouped by Winckworth in the subgenus *Odostomia,* s.s., have larvae with a long pelagic stage and heterostrophic protoconchs. The shell of *O. chitonicola* resembles that of *Odostomia,* s.s., in shape but lacks the heterostrophic protoconch. Possibly this species should be grouped in another subgenus or even in another genus. However, because differences in larval development are often misleading as indications of relationships and because the classification of pyramidellids is at present in a state of confusion, we consider an attempt to refer *O. chitonicola* to another group inopportune.

Twenty-two additional specimens of *Dinoplax gigas,* all with girdles in a fairly good state of preservation, have been examined by us for specimens of *O. chitonicola*; none was found. The chitons came from 8 localities (other than Port Edward) ranging from Gordons Bay (near Cape Town) to Margate, southern Natal. Port Alfred, where Turton found *O. chitonicola,* is one of the localities.

References cited

Allen, J. F. 1958. Naut., *72:* 14.

Ashby, E. 1928. Proc. Malac. Soc. London, *18:* 82-84.

Dautzenberg, Ph. & P. H. Fischer. 1925. Trav. Station Biol. Roscoff, fasc. *3:* 81-82, fig. 1.

Fretter, V. 1955. Proc. Malac. Soc. London, *31:* 143.

Fretter, V. & A. Graham. 1949. J. Mar. Biol. Assoc. U.K., n.s., *28:* 522-523.

Lovén, S.L. 1846. Ofvers. K. [Svensk] Vet.-Akad. Förhandl., *3:* 49, 150.

Macnae, W. 1958. The Mollusca. *In* A Natural History of Inhaca Island, Mocambique, ed. W. Macnae & M. Kalk. Witwatersrand Univ. Press, pp. 86, 88. See also pp. 44, 45, 127.

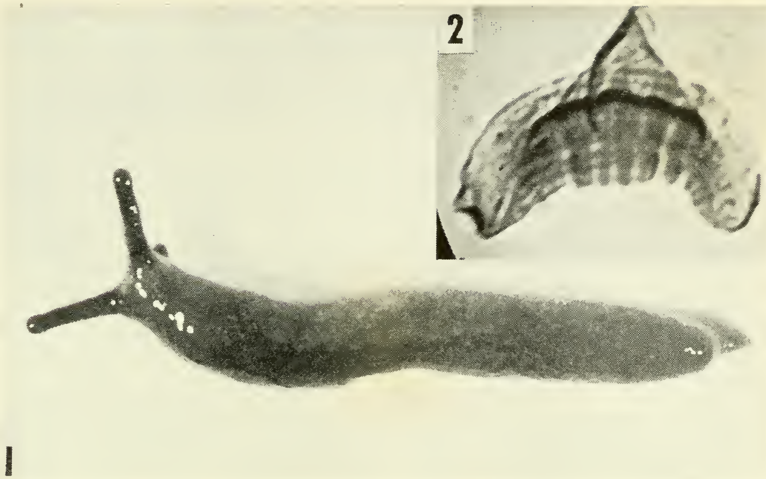
Rasmussen, E. 1951. Vidensk. Medd. Dansk naturh. Foren., *113:* 217, fig. 8.

Sanders, H. L. 1958. Limnology and Oceanography, *3:* 254-255.

—— 1960. Ibid. *5:*149-150.

Smith, E. A. 1899. J. Conchol., *9:* 250, pl. 5, fig. 10.

Thorson, G. 1946. Medd. Komm. Danmarks Fiskeri- og Ha-



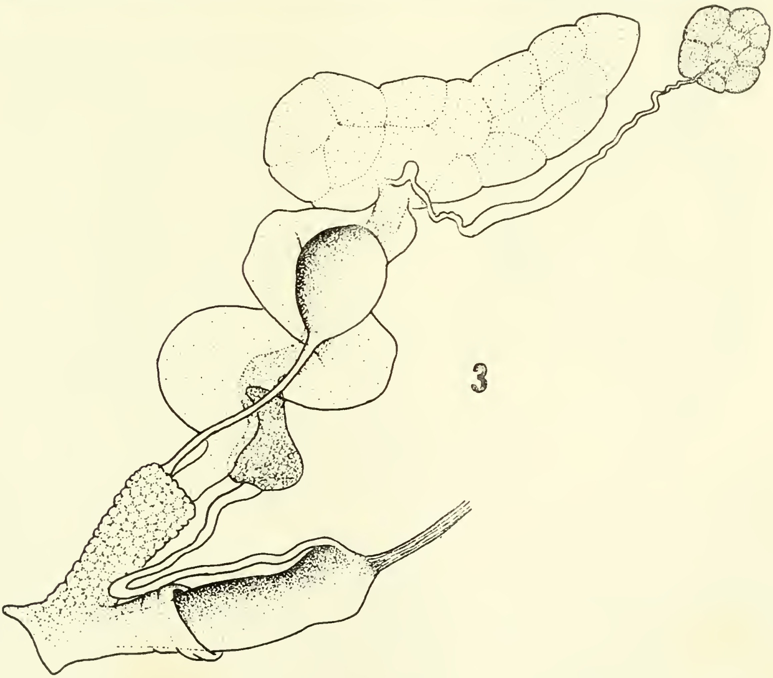
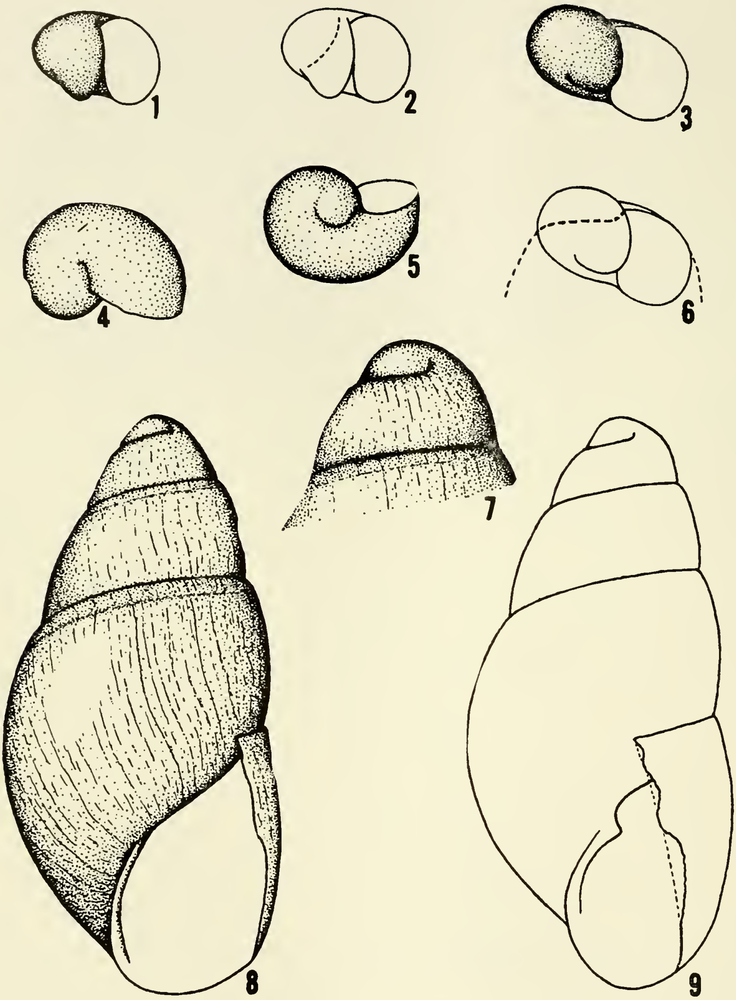


Fig. 1, *Pallifera pilsbryi santaritana,* Miles & Mead, living animal. All white spots are light reflections. (Photo. B. M. Broder). Fig. 2, Photomicrograph of jaw of *P. p. pilsbryi,* M. & M. 100×. (Photo. W. H. McDonald). Fig. 3, Genitalia of *P. p. pilsbryi.* (Mead, del.). [See Naut. *74* (2):75-78.]



Odostomia chitonicola E. A. Smith. Port Edward, Natal, South Africa. Parasitic on girdle of the chiton *Dinoplax gigas* (Gmelin). Fig. 1. Larval shell, apertural view. 2. Diagram of same, the dotted line showing inner edge of columella (seen through transparent shell). 3. Older larval shell, apertural view. 4. Same, apical view. 5. Same, basal view. 6. Diagram of same, showing position of larval shell in apex. 7. Apex of adult shell. 8. Largest shell. 9. Outline of same, oblique view of aperture showing fold on columella. Magnifications: 1 to 7, ×72; 8 & 9, ×53.

vundersögelser, ser. Plankton, *4:* 199-212, figs. 115-124.
Turton, W. H. 1932. Marine Shells Port Alfred S. Africa. Oxford Univ. Press, p. 107.
Winckworth, R. 1932. J. Conchol., *19:* 225-227.

MOLLUSKS AND BRACHIOPODS FROM AFOGNAK AND SITKALIDAK ISLANDS, KODIAK GROUP, ALASKA

By WALTER JACOB EYERDAM

(Concluded from October no.)[1]

Buccinum glaciale Linné, dredged (1, 2).
B. plectrum Stimpson, dredged (1, 2, 3).
B. castaneum triplostephanum Dall, cast on beach by storm (2).
B. baeri Middendorff, rare, under rocks (1-4).
B. baeri moerchianum Fischer, common under rocks.
B. angulosum Gray, one specimen, rare (1).
Volutharpa ampullacea (Middendorff), all localities.
V. ampullacea var. *acuminata* Dall, one example (3).
Alectrion mendica (Gould), under stones (1, 3, 4).
Columbella (Alia) gausapata Gould, 10 fms., not common (4).
C. (Alia) tuberosa Carpenter, rare (3).
Nitidella gouldii Carpenter, dredged, not common (4).
Amphissa columbiana Dall, common under rocks at all stations.
A. reticulata Dall, under rocks, not common (2). Range extended north from Chichagoff Island.
Tritonalia interfossa (Carpenter), not common (1, 4).
Trophon (Neptunea) pacificus (Dall), dredged, rare (1, 2).
T. (N.) beringi (Dall), dredged, rare (3).
T. (N.) multicostatus (Esch.), rare at low tide mark (1).
T. (N.) tenuisculptus (Cpr.), under rocks, low tide (1).
T. (N.) lasia (Dall), under rocks (1).
Thais (Nucella) lamellosa (Gmelin), very common (1, 2, 3).
T. (N.) emarginata (Deshayes), common (4).
T. (N.) canaliculata Duclos, common (1-4).
T. (N.) lima (Martyn), common (1-4).
Balcis randolphii (Vanatta), on sponges (4). *(Melanella = Balcis.)*
B. micans borealis (Bartsch), 20 fms., mud (4).
Turbonilla alaskana Dall & Bartsch, dredged (3).
T. (Mormula) eschscholtzii Dall & Bartsch, 20 fms., mud. Range extended north from Port Simpson, B. C.
T. (Strioturbonilla) vancouverensis (Baird), 10 fms. (3).
T. (Pyrgolampros) alaskana Dall & Bartsch, 15 fms. (4).

[1] On page 41, 2nd line from bottom, insert continental between "largest" and "island." Hawaii is bigger. — W. J. E.

T. (P.) stelleri Bartsch, 15 fms. (3). Type lot.
T. (P.) shuyakensis Bartsch, 15 fms. (3). Type lot.
T. (P.) middendorffii Bartsch, 15 fms. (3). Type lot.
T. (P.) eyerdami Bartsch, 20 fms. (3). Type lot.
Odostomia (Evalea) eyerdami Bartsch, under rocks (3). Type lot.
O. (E.) inflata Dall & Bartsch, under rocks (4). Range extended north from Neah Bay, Washington.
O. (E.) amchitkana Dall & Bartsch, dredged (2, 3, 4).
O. (E.) sitkaensis Clessin, 10 fms. (4). Range extended north from Sitka, Baranoff Island.
O. (E.) tenuisculpta Carpenter, under stones (4).
O. (E.) unalashkensis Dall & Bartsch, 10 fms. (3).
O. (Amaura) krausei Clessin, 10 fms. (3).
O. (A.) kennerlyi Dall & Bartsch, dredged (1, 3, 4). Range extended north from Nanaimo, B. C.
O. (A.) elsa Dall & Bartsch, dredged (1).
O. (A.) sillana Dall & Bartsch, dredged (4). Range extended east from Unalaska, Aleutian Islands.
O. (A.) gouldii Carpenter, dredged (4). Range extended north from Neah Bay, Washington.
O. (A) talpa Dall & Bartsch, (4). Range extended north from Sitka, Baranof Island.
Argobuccinum (Fusitriton) oregonense (Redfield), dredged (2, 4).
Cerithiopsis willettii Bartsch, under rocks on sponges (4).
C. frazeri Bartsch, in bread sponges (1, 4).
C. charlottensis Bartsch, under rocks (2, 3). Range extended north from Queen Charlotte Islands.
C. stejnegeri Dall, under rock (1). Range extended east from Shumagin Islands.
Bittium (Semibittium) vancouverense Dall & Bartsch, under rocks (4). Range extended north from Barklay Sound, B. C.
Trichotropis costellata Couthouy, dredged (1, 3, 4).
T. cancellata Hinds, (1-4). Coprophagous on excreta of the worm, *Serpularia columbiana*.
T. insignis Middendorff, dredged (1-4).
Tachyrhynchus lacteolus (Cpr.), dredged (1, 2).
T. erosus major Dall, dredged (1, 2).
Littorina sitchana Philippi, on rocks (1-4).
L. aleutica Dall, (1). Range extended east from Shumagin Is.
L. rudis Donovan, on stones, common (1-4).
L. (Melaraphe) scutulata Gould, on stones (2, 3, 4).
Lacuna porrecta Carpenter, common (1-4).
L. divaricata (Fabricius), on kelp fronds (1-4).
L. carinata Gould, on algae fronds (1).
L. vincta (Montagu), on algae fronds (4).
L. solidula Loven, on *Fucus*. Range extended north from Puget Sound, Washington.

Haloconcha minor Dall, (4). Range extended east from Chirikoff Island.

Cingula aleutica Dall, on nullipores (4).

C. eyerdami Willett, on nullipores (3). Range extended west from Prince William Sound. (Type locality: Elrington Island.)

C. (Nodulus) cerinella (Dall), on nullipores (3). Range extended east from Kyska Island, Aleutian Is.

C. (N.) kyskensis Bartsch, on nullipores (3). Range extended east from Kyska Island.

Alvania compacta Carpenter, on nullipores (2). Range extended north from Port Etches.

A. sanjuanensis Bartsch, on sponges (4).

A. dalli Bartsch, on sponges (2).

Crepidula (Ianicus) nummaria Gould, on stones (1-4).

C. (I.) nivea C. B. Adams, on stones (1).

C. (Crepipatella) lingulata Gould, on stones (1-3).

Crepidula grandis (Middendorff), 15 fms., on stones (1).

Natica (Cryptonatica) clausa Brod. & Sowerby, uncommon (1-3).

N. (C.) aleutica (Dall), uncommon (1, 3).

Polinices (Euspira) pallidus (Brod. & Sow.), uncommon (1).

P. (E.) groenlandicus (Möller), dredged (1).

Velutina laevigata (Linné) low tide mark, uncommon (1, 2).

Onchidiopsis hannai Dall, on stones near high water (4). Range extended southeast from Pribilof Islands.

Lepeta (Cryptoctenidia) concentrica Midd., low tide mark (1-4).

L. (C.) alba (Dall), low tide mark (1-4).

L. (C.) caecoides Carpenter, dredged (4).

Acmaea mitra Esch., on stones, low tide mark, all stations.

A. mitra funiculata (Carpenter), rare, 00 fms. (2).

A. cassis Esch., between tides, at all stations.

A. cassis pelta Esch., between tides, at all stations.

A. cassis olympica Dall, on mussels, at all stations.

A. cassis nacelloides (Dall), on kelp, at all stations.

A scutum Esch., on rocks, middle tide, at all stations.

A. scutum pintadina (Gould), at all stations.

A. scutum patina Esch., at all stations.

A. digitalis Esch., highest on shore rocks, all stations.

A. testudinalis (Müller), between tide marks, all stations.

A. persona Esch., on stones, at all stations.

A. rosea Dall, rare, dredged, at all stations. Range extended eastward from the Shumagin Islands.

A. instabilis (Gould), on kelp stalks (1, 3, 4).

A. fenestrata Reeve, on inshore rocks (1, 3, 4.)

A. peramabilis Dall, on granite rocks only (3, 4). Range extended eastward from the Shumagin Islands.

Moelleria drusiana Dall, on nullifores (3).

M. quadrae Dall, on nullipores (3, 4).

Calliostoma costatum (Martyn), in tide pools (1-4).
Turcicula bairdi Dall, dredged (3).
Cidarina cidaris (A. Adams), dredged (1, 4).
Solariella (Machaeroplax) varicosa (Mighels & Adams), (2).
Margarites (Pupillaria) pupilla Gould, all stations.
M. (P.) cinerea Couthouy, (2).
Margarites helicinus (Phipps), on stones, low tide mark (1-4).
M. marginatus Dall, under stones, all stations.
M. marginatus laevior Jeffreys, rare, under stones (1).
Diodora aspera (Eschscholtz), smaller size than in Puget Sound; all stations.
Puncturella cucullata (Gould), 15 fms. (1, 2).
P. galeata (Gould), 15 fms., dredged (1, 2, 3).
P. multistriata Dall, rare, 15 fms. (1, 3).
Vitrinella oldroydi Bartsch, under rocks, rare (4). Range extended northward from San Pedro, California.

CEPHALOPODA

Octopus punctata Gabb, under large flat stones (1, 2).
O. honkongensis Hoyle, under rocks, (1, 2, 4).

AMPHINEURA

Lepidopleurus cancellatus (Sowerby), under rocks (1, 2).
Lepidochitona lineata (Wood), common under rocks (1-4).
L. (Tonicella) raymondi (Pilsbry), under stones (4).
L. (T.) submarmorea (Middendorff), under rocks at low tide (1-4).
L. (T.) alba (Linné), under stones at all stations.
Schizoplax brandtii (Middendorff), under stones (4).
Ischnochiton mertensii (Midd.), under rocks (1, 3).
I. trifidus (Carpenter), dredged (3).
Mopalia ciliata (Sowerby), under stones, not common (1, 3). Range extended northward from Vancouver Island.
M. ciliata wossnessenskii (Middendorff), rare (3).
M. muscosa (Gould), under stones, not common (3, 4).
Katherina tunicata (Wood), at all stations.
Cryptochiton stelleri (Middendorff), rare (1).

LAND SHELLS

Euconulus fulvus alaskensis (Pilsbry), under wild rhubarb (1, 4).
Haplotrema vancouverense (Lea), under logs and bark (1-4).
Vespericola columbiana pilosa (Henderson) under logs and bark (1, 2, 4).
Vitrina alaskana Dall, under wild rhubarb (4).
Discus cronkhitei (Newcomb), under wild rhubarb (4).
Vertigo columbiana Sterki, under wild rhubarb (3).
Columella edentula (Draparnaud), under wild rhubarb (3).

FRESH WATER SHELLS

Anodonta beringiana Middendorff, in a small lake (3).
Pisidium eyerdami = *P. abditum* Haldeman = *P. casertanum*

(Poli), in a spaghnum bog (3).
Lymnaea sp., in a small pond (3).
Planorbidae sp., in a small pond (3).

BRACHIOPODA

Hemythyris psittacea (Gmelin), dredged (1, 2, 3).
Terebratalia caurina (Gould), (2, 3).
Terebratulina unguicula (Carpenter), (2).
Laqueus californicus (Koch), (1, 2).

ANNELIDA

Spirorbis occidentalis Stimpson, on *Fucus,* at all stations.

Recently, with the great activity in international, deep-water fishing in the north Pacific and Arctic Oceans by the fisheries of U.S.S.R., Japan and the U.S.A., increased interest is being shown in the study of bottom life of this far northern area of several, distinct faunules. A great deal of systematic, modern collecting still remains to be done in the rich biotic regions of southeast Alaska, Gulf of Alaska and Prince William Sound. With development of controlled, offshore, shellfish dredging, many more rare or new species of mollusks will come to light.

MOLLUSCA OF THE BIG HORN MOUNTAINS

By DOROTHY E. BEETLE

The Big Horn Mountains, a majestic range that curves through north central Wyoming, lie in parts of Sheridan, Johnson, Big Horn and Washakie Counties. The mountains average 40 to 60 miles in width, rising centrally at Cloud's Peak to an elevation of 13,165 feet. To the north and south, the summits gradually decrease. Steep flanks, which ascend abruptly more than 1,000 feet, are characteristic for 200 miles along both the east and west slopes. Above this escarpment gently rolling slopes prevail. Granites are extensively exposed in the high mountain areas. The flanks of the mountains are composed principally of sedimentary rock. Water action, particularly on the western slopes, has carved a myriad of short, straight canyons through them.

On the west, the Big Horn Mountains rise from the Big Horn Basin, an arid lowland approximately 4,000 feet in elevation. To the east they drop away to similar but less arid plains. Big Horn and Washakie Counties, on the western side, average $6\frac{1}{2}$ and $8\frac{1}{3}$ inches of rain respectively. Sheridan and Johnson

Counties each receive 14½ inches annually. On the mountain crest, the climate is generally humid. Toward the end of the brief summer, it may become as dry as the lower plains in years of poor rainfall. Low temperatures prevail in the mountains, with frost and snow possible even in July and August.

The western slopes are sparsely covered with juniper *(Juniperus utahensis),* mountain mahogany *(Cercocarpus montanus),* and big sagebrush *(Artemesia tridentata)* communities. Moist pockets in the canyons, as elsewhere across the range, may have stands of spruce, fir and aspen. The more moist eastern slopes support ponderosa pine *(Pinus ponderosa)* up to 7,000 feet. Lodgepole pine *(Pinus contorta)* forms extensive stands across the top of the range. A predominant feature of the landscape here is the abrupt transition between plant associations. Lodgepole pine gives way to Idaho fescue *(Festuca idahoensis)* to leave open fairways between stands of trees.

Arctic-alpine plants occur at scattered high places from Powder River Pass to the Montana border. Creeks winding across the broad top spread out to produce wet meadows thickly carpeted with marsh plants. Willow thickets border the creeks.

Terrestial Mollusca

Oreohelix pygmaea
O. pygmaea maculata
O. subrudis
O. subrudis obscura
O. yavapai extremitatis
O. yavapai magnicornu
O. carinifera
Euconulus fulvus
Retinella electrina
R. binneyana occidentalis
Zonitoides arboreus
Vitrina alaskana
Deroceras reticulatum
D. laeve
Discus cronkhitei
D. shimeki
D. shimeki cockerelli
Punctum minutissimum
Oxyloma decampi gouldi
Succinea grosvenori
S. stretchiana
S. avara
Pupilla blandi
P. muscorum
P. hebes
Vertigo gouldi basidens
V. concinnula
V. modesta
V. modesta parietalis
Columella edentula
C. alticola
Vallonia pulchella
V. excentrica
V. gracilicosta
V. albula
V. cyclophorella
Zoogenetes harpa

Aquatic Mollusca

Galba doddsi
G. caperata
G. parva
G. dalli

G. humilis modicella
G. humilis rustica
G. obrussa
G. palustris
G. jacksonensis
Gyraulus circumstriatus
G. parvus
Helisoma trivolvis
H. trivolvis macrostomum
H. subcrenatum
Promenetus umbilicatellus
Physa ampullacea
Physa anatina
Physa integra
Physa smithiana
Aplexa hypnorum
Pisidium casertanum

LOCALITIES

Examples of all the species listed are in the Beetle collection.

Sheridan County: Sheep Creek near Freezout Peak: *Oreohelix subrudis, Euconulus fulvus, Vitrina alaskana, Vertigo modesta, V. modesta parietalis.* Fool's Creek near Freezout Peak: *Gyraulus parvus.* Tongue River, island in plant relic area near Sibley Lake, grass: *Oreohelix pygmaea, O. subrudis, Lymnaea caperata.*

University Wyoming Experimental Pastures 1 mile west of Burgess Ranger Station, willow thickets along Tongue River: *Oreohelix pygmaea, O. subrudis, O. subrudis obscura, Deroceras laeve, Discus cronkhitei, D. shimeki, D. shimeki cockerelli, Punctum minutissimum, Succinea avara, Pupilla hebes, Vertigo concinnula, Vallonia cyclophorella, Euconulus fulvus, Vitrina alaskana.* Same locality, wet meadow, dwarf willows, thick mats of *Carex,* marsh plants, *Sphagnum,* snails crawling on plants, caddis fly cases thickly camoflagued with all the mollusks: *Deroceras laeve, Discus cronkhitei,* immature *Succinea, Vertigo gouldi basidens, V. concinnula, V. modesta, V. modesta parietalis, Columella edentula, Galba caperata, G. parva, G. humilis rustica, Aplexa hypnorum, Pisidium casertanum.*

Five miles west of Bear Lodge, limestone bluff above Tongue River, aspen grove: *Oreohelix pygmaea, Eueonulus fulvus, Zonitoides arboreus, Vitrina alaskana, Pupilla hebes, Vertigo concinnula.* Same locality, lodgepole pine: *Euconulus fulvus, Zonitoides arboreus, Vitrina alaskana, Deroceras reticulatum, D. laeve, Vertigo modesta.*

Little Willow Creek near Burgess Jct., muddy pond, snails crawling on reeds and rocks along shore: *Succinea avara, Galba caperata, Gyraulus circumstriatus, G. parvus, Physa ampullacea, Pisidium casertanum.* Spruce grove 5 miles east of Burgess Jct., limestone: *Euconulus fulvus, Zonitoides arboreus, Pupilla hebes, Vallonia cyclophorella.* Owen River at U.S. 14: *Deroceras laeve, Succinea avara, Galba caperata, Pisidium casertanum.* Sibley Lake, dry west slope, spruce: *Oreohelix pygmaea, Euconulus fulvus, Vitrina alaskana, Discus shimeki cockerelli, Vertigo modesta parietalis, Physa smithiana.*

Tongue River at Ranchester, willows, 3775 feet: *Vitrina*

alaskana, Vallonia excentrica, V. gracilicosta, slug, *Galba dalli, Physa anatina.*

Sheridan, University Wyoming Experiment Station, in lawn: *Vallonia pulchella,* in roots of bent grass, *Vallonia excentrica.* Story, mineral spring at Fish Hatchery: *Galba humilis modicella, Pisidium casertanum.* Story, mouth of South Fork Canyon, pine, maple, serviceberry, limestone, 5000 feet: *Oreohelix subrudis obscura, Euconulus fulvus, Retinella binneyana occidentalis, Zonitoides arboreus, Vitrina alaskana, Discus cronkhitei.*

South Fork Canyon 2 miles from mouth, aspen, pine, cottonwood, limestone cliffs: *Oreohelix pygmaea, O. subrudis obscura, Retinella binneyana occidentalis, Zonitoides arboreus, Vitrina alaskana, Discus cronkhitei,* immature *Pupilla, Vallonia albula.* Piney Cruse Creek at Story, bog, willow, alder, aspen: *Euconulus fulvus, Retinella binneyana occidentalis, Zonitoides arboreus, Vitrina alaskana. Discus cronkhitei, D. shimeki cockerelli, Oxyloma decampi gouldi,* immature *Vertigo, Zoogenetes harpa,* slug. Big Piney Creek at U.S. highway 87, on stones: *Gyraulus parvus, Physa smithiana.*

Johnson County: Lake de Smet, sandy, 4600 feet: *Gyraulus parvus, Physa anatina.* Clear Creek: *Galba palustris, Gyraulus parvus, Physa anatina.* 19 miles west of Buffalo, U.S. highway 16, stock pond, muddy, 7900 feet: *Galba palustris, G. jacksonensis.* Same locality, willows along creek, granite: *Euconulus fulvus, Vitrina alaskana, Discus cronkhitei, D. shimeki cockerelli, Pupilla blandi, Vertigo concinnula, V. modesta, Columella alticola.* Same locality, spruce on north slope: *Zonitoides arboreus, Discus shimeki, D. shimeki cockerelli, Vertigo modesta parietalis.* Same locality, east slope, aspen, pine, willow on granite: *Euconulus fulvus, Retinella binneyana occidentalis, Zonitoides arboreus, Vitrina alaskana, Discus cronkhitei, D. shimeki cockerelli, Pupilla hebes, Vertigo concinnula, V. modesta, V. modesta parietalis, Vallonia albula, V. cyclophorella.*

Trail to Sherd Lake, muddy pond, 8400 feet: *Galba palustris, G. jacksonensis, Promenetus umbilicatellus, Pisidium casertanum.* Trail to Sherd Lake, mature lodgepole pine on old burn, granite: *Zonitoides arboreus, Discus cronkhitei, Vertigo concinnula.* Porcupine Creek near Powder River Pass, 9500 feet, dwarf willow, granite: *Euconulus fulvus, Vitrina alaskana, Deroceras laeve, Succinea stretchiana, Vertigo modesta.* Powder River Pass, 9666 feet, mountain, meadow with scattered spruce, granite, under logs along creek: *Vitrina alaskana, Deroceras laeve, Vallonia albula, Galba palustris.*

Washakie County: Meadowlark Lake, aquatic vegetation along shore, sandy: *Galba caperata, Gyraulus parvus.* Swamp near Buck Creek above Tensleep Canyon: *Galba palustris, Helisoma subcrenatum.* Near West Tensleep Lake, swampy area, pine,

aspen, willow, in leaf debris and moss, 8500 feet: *Euconulus fulvus, Retinella binneyana occidentalis, Zonitoides arboreus, Pupilla hebes, Vertigo modesta parietalis, Galba palustris, Promenetus umbilicatellus, Pisidium casertanum.*

Worland, Big Horn River, muddy backwater, 4061 feet: *Oxyloma decampi gouldi, Galba palustris, Physa smithiana.* Tensleep, slough off Tensleep River, 4206 feet: *Galba caperata, G. obrussa, Helisoma trivolvis, H. subcrenatum, Physa integra.* Tensleep Canyon near the mouth, south slope, 5300 feet, in rock crevices and at base of plants, sandy, scattered pine, mountain mahogany: *Oreohelix yavapai extremitatis, Succinea avara, Pupilla hebes, Vallonia cyclophorella.*

Tensleep Canyon, ½ mile below Fish Hatchery, north slope, 5400 feet, sedimentary rock, open groves of juniper, pine, maple, douglas fir, currant: *Oreohelix pygmaea, O. subrudis, O. yavapai extremitatis, Euconulus fulvus, Pupilla hebes, Vallania albula, V. cyclophorella.* Same locality, south slope, dry, mountain mahogany: *Oreohelix pygmaea, O. subrudis, O. carinifera, Zonitoides arboreus, Vitrina alaskana, Pupilla hebes, Vallonia gracilicosta, V. cyclophorella.* Near head of Tensleep Canyon, 6800 feet, limestone, aspen grove, north slope: *Oreohelix pygmaea, O. subrudis, Euconulus fulvlus, Zonitoides arboreus, Vitrina alaskana, Discus cronkhitei, Pupilla muscorum, Vallonia gracilicosta.* Same locality, limber pine, douglas fir: *Oreohelix pygmaea, O. subrudis, Euconulus fulvus, Zonitoides arboreus, Pupilla hebes, Vallonia albula.*

Leigh Canyon, creek at Fish Hatchery: *Lymnaea doddsi, Physa integra, Pisidium casertanum.* Leigh Canyon behind the Fish Hatchery, thick growth of conifers and hardwoods along creek: *Oreohelix subrudis, O. subrudis obscura, Zonitoides arboreus, Vitrina alaskana, Deroceras reticulatum, Discus cronkhitei, Succinea avara, Vallonia pulchella,* slug. Leigh Canyon, 1 mile above hatchery, 6000 feet, slough: *Retinella binneyana occidentalis, Vallonia cyclophorella, Lymnaea doddsi.* Leigh Canyon, southwest slope, dry, sandy, mountain mahogany, cedar: *Oreohelix subrudis, O. subrudis obscura, O. yavapai extremitatis, O. yavapai magnicornu, Zonitoides arboreus, Vitrina alaskana, Pupilla hebes, Vallonia albula, V. cyclophorella.*

Bighorn County: Medicine Wheel Ranger Station, pond: *Pisidium casertanum.* Bluff above Porcupine Creek, north slope: *Succinea grosvenori.* Cliffs below Medicine Wheel, 8950 feet, limestone, pine, aspen, sagebrush: *Oreohelix subrudis, Vallonia cyclophorella.* Canyon below Medicine Wheel, douglas fir, spruce, limber pine: *Oreohelix pygmaea, O. subrudis, Vallonia albula.* Five Springs Camp, Rt. 14, under mossy logs in seepage: *Oreohelix pygmaea, Euconulus fulvus, Vitrina alaskana, Vertigo modesta,* slug. Five Springs Creek at Rt. 14, granite, spruce:

Oreohelix pygmaea, O. subrudis, Zonitoides arboreus, Discus shimeki.

Mouth of Dayton Kane Canyon, juniper, under sedimentary rocks along creek: *Vallonia gracilicosta.* Spring Creek at Shell, willows, slough, 4210 feet: *Retinella electrina, Zonitoides arboreus, Deroceras laeve, Oxyloma decampi gouldi, Succinea avara, Galba parva, G. palustris, Physa integra.* Base of Shell Canyon, Kerchner Ranch, pond, shallow, heavily vegetated: *Galba obrussa* 355, *Physa smithiana.*

Dry Fork Canyon 4 miles northeast of Shell, sedimentary rock, maple, willow, silver sage, poison ivy: *Oreohelix yavapai extremitatis, Zonitoides arboreus, Pupilla muscorum, P. hebes, Vallonia albula, V. cyclophorella.* Same locality, moss lined cave in talus that creek tumbled through: *Galba doddsi.* White Creek Canyon, dry streambed, cottonwood, juniper, sage, poison ivy: *Oreohelix pygmaea maculata, O. subrudis, O. subrudis obscura, O. carinifera, Vitrina alaskana, Vallonia cyclophorella.*

Shell Canyon, Shell Creek at the bridge, limestone, pine, cottonwood, maple, in leaf debris: *Oreohelix pymgaea, O. pygmaea maculata, O. subrudis, O. carinifera, Discus shimeki cockerelli, Vallonia gracilicosta.* Shell Canyon, ¼ mile above largest switchback on old road, juniper, under rocks: *Oreohelix pygmaea, O. pygmaea maculata, O. yavapai extremitatis, Zonitoides arboreus, Pupilla hebes, Vallonia albula, V. gracilicosta.* Shell Canyon, Granite Creek Camp, 7700, feet, aspen: *Oreohelix pygmaea, O. pygmaea maculata, O. subrudis, Euconulus fulvus, Retinella electrina, Vitrina alaskana, Discus cronkhitei, D. shimeki cockerelli, Pupilla muscorum, Vertigo concinnula, Vallonia albula* in creek, *Pisidium casertanum.* 2 miles west of Granite Pass, Rt. 14, mature lodgepole pine: *Euconulus fulvus, Vitrina alaskana.*

The abundance of *Oreohelix* was a characteristic feature of the Big Horn Mountains. *Oreohelix subrudis, O. subrudis obscura, O. pygmaea,* and *O. pygmaea maculata* were widely spread above 4500 feet. In addition, *Oreohelix carinifera, O. yavapai extremitatis,* and *O. yavapai magnicornu* appeared in canyons along the western rim. Colonies were located under talus, in crevices in the cliffs, at the base of plants on dry hillsides, and in all the major plant associations. Variations in diameter, height of spire, width of umbilicus, carination, and color pattern pointed to this area as one of active speciation in the genus.

Three species of *Vallonia, V. albula, V. gracilicosta,* and *V. cyclophorella* were usually associated with *Oreohelix,* and were

much more abundant on the east and west slopes of the range than on the summit. The separation of the three became difficult because almost all mature individuals developed expanded and thickened lips. Three groups of shells with slight variation in size of lip were measured and the number of ribs counted. Only individuals with a diameter of 2.5 mm. or more were used. The 90 shells with the greatest lip expansion had a rib count of 41-60 ribs. An intermediate group of 118 shells had 42-55 ribs; 54 shells with the smallest lip had 45-68 ribs. Localities often had specimens that ranged through all of the groups.

Pupilla hebes was often associated with species of *Oreohelix* and *Vallonia.* It occurred in great numbers on sedimentary outcrops. Aspen groves on limestone ridges above the Tongue River were populated by the largest colonies of *Pupilla hebes* seen anywhere in Wyoming.

Succinea avara, a fairly common snail in Wyoming, occurred in Tensleep Canyon in conjunction with *Oreohelix yavapai extremitatis* and *Vallonia cyclophorella* at an elevation of 5300 feet. The three species were living under rocks on the sunbaked, sandy south slopes. A particular search for *Succinea avara* turned up a single shell behind the fish hatchery.

Canyons similar to Tensleep Canyon along the west escarpment were found to contain populations of *Oreohelix, Vallonia,* and *Pupilla,* but no *Succinea.* However, farthur south, *Succinea avara* was discovered along the cliffs of the Wind River Canyon in Hot Springs County in just such a setting as that of Tensleep Canyon.

A comparison of the number of species collected in a given habitat in the Teton or the Medicine Bow Mountains with the number collected in the Big Horn Mountains showed fewer species but more individuals were present in the latter. This situation may result from the greater exposures of sedimentary rock in the Big Horn range. In both the Teton and Medicine Bow Mountains, a diversity of soils and plant associations together with more favorable moisture conditions may be reflected in the larger species lists for all habitats.

An effect of the weather on the snail population was noticed on the northern summits of the Big Horns. In 1956, collections in July revealed an abundance of animals at most sites. For

6 weeks during May and the beginning of June, 1957, heavy rains fell almost daily. In mid-July the same sites were revisited. Spring flowers were at the height of their display, but the ground was still wet. Even under logs and stones the soil was washed quite bare of debris. Only a few, mainly immature, snails were active. Eggs were exposed in tangles of debris where their survival was doubtful. A check in 1958 showed a population smaller than that of 1956.

Field work in the Big Horn Mountains was conducted in July of 1956, 57, and 58. Grateful acknowledgement is made to the Wyoming Chapter of Sigma Xi for two grants-in-aid which partially assisted the author to carry on these studies.

References

Baker, F. C. 1911. The Lymnaeidae of North and Middle America. Chicago Acad. Sci. Spec. Publ. 3.

—— 1945. The Molluscan Family Planorbidae. Univ. Ill. Press, Urbana.

Beetle, A. A. 1956. Range survey in Wyoming's Big Horn Mountains. Wyo. Agr. Ex. Sta. Bull. 341.

Dunnewald, T. J. 1930. Grass and timber soils distribution in the Big Horn Mountains. Jour. Amer. Soc. Agron. *22:* 577-586.

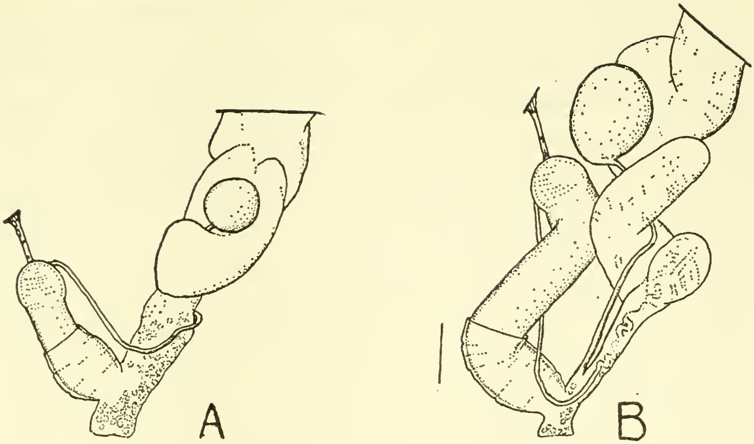
Pilsbry, H. A. 1939-1948. Land Mollusca of North America. North of Mexico. Acad. Nat. Sci. Philadelphia, Monographs 3.

PALLIFERA FOSTERI, WITH P. MEGAPHALLICA, NEW

By F. WAYNE GRIMM
Michigan State University, East Lansing, Mich.

Pallifera (Pancalyptus) fosteri F. C. Baker. Text-fig. A

This species has been reported from several midwestern localities (Baker, 1939; Pilsbry, 1948; Webb, 1952), from the southern Atlantic coastal plain (Hubricht, 1953; Grimm, 1960); and specimens resembling it have been reported from Michigan and Ontario (Pilsbry, 1948). In 1952, Webb published a brief description of the genitalia of immature specimens from 30 miles west of the type locality. Included with this description was a more complete description of the mature anatomy of a color form, *P. fosteri oughtoni* Webb. Essentially, the genitalia of specimens from the Sanford Woodlot of Michigan State University, East Lansing, Ingham Co., Michigan, agree with



Anterior genitalia of *Pallifera*. A, *P. fosteri*, Ingham Co., Michigan. B, *P. megaphallica*, from type lot (ANSP. 251839). Scales=approximately 1 mm.

the description and figures published for *P. fosteri* and *P. f. oughtoni* from Illinois. For comparative purposes, however, the following information concerning Michigan examples is presented.

Animal: Mantle very light tan, spotted and reticulate with dark brownish gray. The reticulations are heaviest in the middle of the back, but no dorsal line is formed. At the sides, the reticulations form two broken lateral lines. The tentacles are slate gray, and the anterior margin of the foot is brownish red. Length (preserved) 10 to 17 mm.

Genitalia: Atrium short and glandular near the vagina, which is largely enveloped in glandular tissue. Spermatheca small, globular, and placed at the end of a thin, non-expanded stalk which is somewhat longer than the penis. The thick and tubular penis is about 2 mm. long and bears a basal sheath of slightly less than 1 mm. in length. The apical region of the penis is thin, subtranslucent and slightly expanded, and the penial retractor is short. The genitalia differ from *P. f. oughtoni* only in having a slightly more extensive vaginal gland and a somewhat larger penial retractor.

The mantle pattern of this lot differs from that of *oughtoni* in being marked with brownish gray, not black, and in having less prominent lateral lines.

Pallifera (Pancalyptus) megaphallica, new species.

Text-fig. B

Animal: Markings similar to those of *P. fosteri* from Michigan except that the mantle reticulations are darker gray, a distinct dorsal line is present, and the lateral lines are blackish. In the type lot, the brownish red sides of the foot are less prominent or are absent altogether. Length (preserved) 13 to 19 mm. (holotype largest; not dissected).

Genitalia: Atrium short, slightly glandular near the vagina. Vagina short and free of glandular tissue. Spermatheca larger than that of *P. fosteri;* placed upon a thin non-expanded stalk which is equal to or slightly less than the penis in length. The thick and tubular penis is about 6 mm. long, is twisted a full turn, and bears a basal sheath approximately 2 mm. in length. Apex of penis as in *fosteri*. Internally, the tip of the penis is circularly striate and the penis bears an elongate, variously wrinkled pilaster which hangs loosely from a sub-apical origin and extends nearly to the region of the sheath. Penial retractor short, only slightly longer than that of *fosteri*. The albumen gland is much reduced, and the hermaphrodite duct is greatly swollen.

Jaw arched and centrally plicate, as in *P. fosteri*.

Distribution. Maryland: Worcester Co.: among wet leaves and cypress needles near small creek, dump along Pocomoke River, west-southwest edge of Snow Hill, type (Acad. Nat. Sci. Philadelphia no. 251838) and paratypes ANSP. 251839-40; other paratypes in the author's collection; Porter's Crossing, Pocomoke Cypress Swamp north of Snow Hill; logs beside U.S. 113 near Mattaponi Creek; 0.5 mile south of Girdletree. Wicomico Co.: Royal Oak; roadside near Quantico forest fire tower on Md. 349; near bridge at Mill Branch, 1 mile south of Mardela Springs; under logs along Md. 354, 2.1 miles south of Willards; under logs, 1 mile south of Bivalve. Caroline Co.: near bridge at Hunting Creek. Queen Annes Co.: roadside near Normans, 3 miles south of Stevensville, Kent Island; woods immediately north of Stevensville, Kent Island. St. Mary's Co.: Oaks, at railroad crossing. Charles Co.: 2 miles southeast of La Plata on Md. 6; valley of Hell's Bottom Run between Dentsville and Oliver's Shop; woods .8 mile east-southeast of Bryan's Road; valley of Old Woman's Run, 1 mile south of Bennesville. Anne

Arundel Co.: Bodkin Plains, near Pasadena; Leon, on the Patuxent River. Prince Georges Co.: valley of Walker Branch, west end of Laurel, Baltimore Co.: Relay; northwest corner of cemetery, Woodlawn; dump in upland oak woods near Patapsco State Park off Hilton Ave., Catonsville.

Pallifera megaphallica is very closely related to *P. fosteri,* and differs from the latter primarily in the enormous size of the penis, which is visible through the body wall. The degree of twisting of the penis, the sizes of the albumen gland and hermaphrodite duct, as well as the amount of glandular tissue on the vagina and atrium vary among the several lots seen. Perhaps this variation may be correlated with the sexual cycle. Juveniles of *megaphallica* have a longer and more slender penis than adult *fosteri.* Intensity of color is also extremely variable; specimens from dry localities are quite well marked, whereas those of wetter regions are generally of less heavy pigmentation. Occasionally a specimen will lose nearly all its markings and retain only a trace of the lateral lines.

In Maryland, *P. megaphallica* is the common coastal-plain species. It extends into the piedmont near the fall-line. Adults appear by December 19 and persist at least until May 10. They have a seasonal life cycle, as does *P. fosteri* in Michigan. Hubricht's (1953) record for *P. fosteri* in Somerset Co., Md., undoubtedly pertains to this species. Probably his additional coastal localities, from Virginia to Georgia, are also based on *megaphallica.*

References

Baker, F. C. 1939. Fieldbook of Illinois Land Snails. Ill. Nat. Hist. Survey Manual No. 2 (Urbana, Ill.) 1-166, figs. (see p. 133).

Grimm, F. Wayne, 1960. Two new succineids from Maryland, with notes on *Catinella vermeta.* Naut. *74:* 8-16. (*P. fosteri* in Md.).

Hubricht, Leslie, 1953. Land snails of the southern Atlantic Coastal Plain. Naut. *66:* 114-125.

Pilsbry, H. A. 1948. Land Mollusca of North America (north of Mexico). Acad. Nat. Sci. Phila. Monogr. 3, vol. *2:* (2) 521-1113 (see p. 768).

Webb, G. R. 1952. Pulmonata, Philomycidae: anatomical data on the slugs *Pallifera dorsalis, P. fosteri* and a new subspecies. Gastropodia *1:*6-7.

LAND SNAILS FROM THE UPPER PATUXENT ESTUARY MARGIN (MARYLAND)

By F. WAYNE GRIMM
Michigan State University, East Lansing

Originating in the high hills of the outer Piedmont south of Ridgeville, Maryland, the Patuxent River flows south-southeastward in a curve through the coastal plain and into Chesapeake Bay. Its course roughly parallels that of the lower Potomac River, and it forms the largest estuary of the west shore of the Chesapeake north of the Potomac. Salt marshes and sandy beaches form the margin of the lower 25 miles of the estuary. As one progresses upstream from the mouth, the salinity of the water gradually decreases and the estuarine marshes become more extensive. Tidal influence is prominent well into the region of the fresh-water marshes.

During a soaking rain on July 12, 1959, the author visited the eastern margin of the upper Patuxent estuary at Leon, Anne Arundel Co., Maryland (Pig Point). At this locality the tidal marshes bordering the river are entirely fresh water. Tobacco fields lie upon the gentle slopes above the marshes, and occasional patches of mixed pine-hardwood forest occupy the fallow land. Land snails were taken from several environments at this station: (1) on mud and debris at the bases of reeds; (2) above the waterline on standing vegetation in the river; (3) on and at the roots of marginal vegetation (nettles).

On April 3, 1960 (also during a rainstorm), this station was revisited, and specimens were collected under fallen marginal vegetation. At this date no attempt was made to collect in the river, which was entering the flood stage. Dump debris in a small, leafy gulch near the roadside immediately above the river yielded additional specimens. Directly across the river at Mount Calvert, Prince Georges Co., only 3 specimens of 2 species were found under a log. A yacht dock is located at this place; both it and the marshes were flooded. Below are listed the species found at each station. Numbers which follow the names indicate either the environment to which a particular species appeared to be limited or the environment in which it was most abundant.

Leon, Anne Arundel Co., near the river margin, July 12, 1959: *Mesodon thyroidus* (Say) (3); *Triodopsis hopetonensis obsoleta*

(Pils.) (3); *Retinella indentata* (Say) (1,3); *Ventridens ligera* (Say) (3); *Zonitoides arboreus* (Say), dead, (3); *Deroceras laeve* (Müll.) (1,2,3); *Catinella hubrichti* Grimm (1); *Catinella* sp.?, dead, (3); *Succinea ovalis* Say, primarily on nettles, (3); *Oxyloma effusa* (Pfr.) (2); *Gastrocopta contracta* (Say) (1,3); *Vertigo ovata* Say (1,3); *Carychium exiguum* (Say) (3); *Pomatiopsis lapidaria* (Say) (1,3).

Leon, Anne Arundel Co., under fallen marginal vegetation, April 3, 1960: *Triodopsis hopetonensis obsoleta* (Pils.); *Ventridens ligera* (Say); *Catinella hubrichti* Grimm, dead; *Catinella* sp.?, dead; *Succinea ovalis* Say; *Oxyloma effusa* (Pfr.), dead adults, living juveniles; *Deroceras laeve* (Müll.); *Pallifera fosteri* F. C. Baker; *Pomatiopsis lapidaria* (Say).

Leon, Anne Arundel Co., dump debris in small gulch near roadside above river, April 3, 1960: *Stenotrema barbatum* (Clapp); *Retinella indentata* (Say); *Ventridens ligera* (Say); *Zonitoides arboreus* (Say); *Succinea ovalis* Say; *Philomycus carolinianus* (Bosc).

Mount Calvert, Prince Georges Co., under log: *Triodopsis juxtidens* (Pils.); *Ventridens ligera* (Say).

The occurrence of *Triodopsis hopetonensis obsoleta* in this region deserves further comment, for the nearest known localities for *T. hopetonensis* (Shutt.) are approximately 70 miles southeast of the above, on the lower Delmarva Peninsula. Although most of the adjacent coastal plain of Maryland west of the Chesapeake has been searched, no *T. hopetonensis* have been found. The nearest locality west of the Chesapeake is in the region of Norfolk, Va., about 120 miles directly south. Thus, the population of *T. h. obsoleta* at Leon appears to be isolated from any known population of a related form.

In all specimens seen (96 collected April 3, 1960; 5 on July 12, 1959), a striking degeneration of apertural teeth is evident. Only 11 retain a trace of the upper lip tooth as a minute vestigial thickening of the peristome; in all others this tooth is absent. However, all mature examples possess both a parietal tooth (a tiny nodule) and a lower lip tooth of variable size. The umbilicus is wider than that of most Delmarva specimens. Occasionally, examples resembling the above in degeneration of the teeth will appear in large lots of *T. hopetonensis* from the Delmarva.

Accidental introduction may account for the presence of this snail at a locality so far removed from its known range. Tobacco

farms near the area collected cannot be ignored as possible sources of introduction. Conceivably, both the reduction of teeth and uniformity of appearance could be due to genetic drift within a small, isolated, inbred population. As a rule, large lots of *hopetonensis* from within the known range of the species show considerable over-all variation individually, although some uniformity of size exists.

On the basis of field observation, Hubricht (1953: 118-121) considers *obsoleta* to be a distinct species closely allied to and hybridizing with *T. messana* Hubricht. Although *T. hopetonensis* appears to be intermediate between the two, Hubricht states that it, too, is a distinct species which resembles hybrids between *T. fallax* (Say) and *T. obsoleta*. In the same article, *obsoleta* is reported from several localities on the Delmarva Pensinsula, both in Maryland and in Virginia, and *T. messana* is reported from Maryland. Unfortunately, all the present author's observations are limitel to Maryland and Virginia. No "pure" colonies of *obsoleta* have yet been observed on the Delmarva Peninsula; but many variable lots which appear to be largely *hopetonensis* have been examined and tentatively referred to that species. Occasional specimens approach either *obsoleta* or *messana*, and specimens from one locality appear to be all *messana*. Only further collecting, supplemented by dissection and breeding experiments, can resolve the taxonomic problem presented by the heterogeneous assemblage of coastal plain *Triodopsis*. Speculation leads to the tentative supposition that the group which includes *T. fallax, messana, obsoleta, hopetonensis,* and *vannostrandi* constitutes a superspecies of typically distinct forms which have not yet evolved to the point of reproductive isolation.

The name *Oxyloma effusa* (Pfr.) is assigned arbitrarily to a large lot collected at the Leon locality. The shells range from the form of *O. effusa* through that of *O. e. subeffusa* Pils. to that of *O. salleana* (Pfr.). Some specimens are up to 20 mm. in length. Variation in the appearance of the sheathed male organ is fully as great as variation in shell shape. The penes and epiphalli of specimens examined exhibit considerable differences in the degree of twist, in the position of the appendix, and in the size of the appendix. No correlation between the shape of the shell and the form of the male organ has been observed.

Other, smaller lots of coastal plain oxylomas show less over-all variation than this one. Unfortunately, insufficient numbers of specimens are available for a thorough study of these phenomena of variation.

Incidentally, a single lot of *Catinella hubrichti* Grimm (1960) from Caroline Co., Md., shows as much variation in shell form as the above discussed *Oxyloma;* the shells ranging in form from that of *Oxyloma decampi gouldi* through that of *O. effusa.*

The following are additional Maryland localities for *Catinella;* see Grimm (1960):

Catinella hubrichti. Mud flats near bridge at Hunting Creek, Caroline Co., near Dorchester Co. line (April 13, 1957). Margin of Big Mill Pond, Swanscut Creek at Welbourne, Worcester Co. (March 27, 1960).

Catinella pinicola. Bald Friar, on the Susquehanna R., Cecil Co. (Nov. 1, 1958). River Road along Susquehanna north of Glen Cove, Harford Co. (Nov. 22, 1958). Near bridge at Mill Branch, 1 mile south of Mardela Springs, Wicomico Co. (March 26, 1960). Dump near valley of Wagram Swamp Branch, 3 miles south-southeast of Pocomoke City, Worcester Co. (March 27, 1960). Approx. 1 mile west of George Isl. Landing and 2 miles east of Stockton, Worcester Co. (March 27, 1960). Boxiron Creek at bridge, Boxiron, Worcester Co. (March 27, 1960).

Catinella vermeta. Baltimore, Harford, and Caroline Counties.

References

Grimm, F. Wayne. 1960. Two new succineids from Maryland, with notes on *Catinella vermeta.* Naut. *74:*8-15, fig. 1, pl. 1.

Hubricht, Leslie. 1953. Land snails of the southern Atlantic coastal plain. Naut. *66:* 114-125.

Pilsbry, H. A. 1940-1948. Land Mollusca of North America (north of Mexico). Acad. Nat. Sci. Philadelphia Monogr. *3,* v.1 part 2, and v.2.

THE UNIONIDAE OF OTTAWA COUNTY, MICHIGAN

By WILLIAM H. HEARD

Museum of Zoology, University of Michigan

Ottawa County, Michigan, is located along the shore of Lake Michigan on the western edge of the lower peninsula. It contains the lower reaches and mouth of the present Grand River which formerly played a major role in the drainage of glacial waters. Several studies of Michigan unionids have dealt with those species of this stream and its tributaries. Coker, et.al.

(1921), listed 22 naiades between Grand Rapids, just east of the Ottawa-Kent County boundary, and Grand Haven at the mouth of the Grand River. Van der Schalie (1941) reported 16 unionids in the Grand River and its tributaries in Ottawa County, while recording 29 species for the entire drainage. In a later study (1948), designed to determine the degree of depletion in the Grand River, he again discussed the naiades of the stream, reporting 17 species.

All specimens on which this report is based are in the collections of the Mollusk Division of the University of Michigan Museum of Zoology. This study was undertaken (1) to compile a list of the highly varied mussel fauna of Ottawa County, and (2) to investigate the present mussel resources of the area in the light of factors which tend to deplete or destroy them, such as clamming for button factories, dredging of the stream channel, and pollution. The assistance of Dr. Henry van der Schalie in making taxonomic determinations and in reviewing the manuscript is gratefully acknowledged.

A list of the extensive naiad fauna of Ottawa County follows. Subspecific designations were used sparingly because most of them represent ecological forms rather than true varieties. For example, *Anodonta grandis footiana* and *A. g. gigantea* were lumped with *A. grandis*. In the following list, it is interesting to note that the fauna is well represented in all three subfamilies of the Unionidae.

UNIONINAE

Amblema costata
Amblema peruviana
Cyclonaias tuberculata
Elliptio dilatatus
Fusconaia flava
Fusconaia undata
Pleurobema cordatum coccineum
Quadrula pustulosa
Quadrula quadrula

ANODONTINAE

Alasmidonta calceolus
Alasmidonta marginata
Anodonta grandis
Anodonta marginata
Anodontoides ferussacianus
Lasmigona complanata
Lasmigona compressa
Lasmigona costata
Strophitus rugosus

LAMPSILINAE

Actinonaias carinata
Actinonaias ellipsiformis
Carunculina parva
Lampsilis siliquoidea
Lampsilis ventricosa
Leptodea fragilis
Leptodea laevissima
Ligumia recta latissima
Micromya iris
Obliquaria reflexa
Obovaria olivaria
Proptera alata
Truncilla donaciformis
Truncilla truncata

Several reports have stressed that there is an increasing number of mollusk species as one proceeds from the headwaters of a stream toward its mouth. The collections considered here are in accordance with this view. Consequently, the streams are arranged according to their size, and the species of mussels are given according to their ecological distribution.

Crockery Creek, Rush Creek, and Sand Creek are tributaries of the Grand River and may be considered to be small streams. Since they are tributary to the Grand River in its lower reaches rather than in the headwaters, a few species such as *Quadrula pustulosa* and *Actinonaias carinata* enter these small streams. Ordinarily these species are associated with larger rivers. These tributaries were found to harbor the following species:

Amblema costata
Elliptio dilatatus
Fusconaia flava
Quadrula pustulosa
Alasmidonta calceolus
Anodonta grandis
Anodontoides ferussacianus
Lasmigona complanata
Lasmigona compressa
Strophitus rugosus
Actinonaias carinata
Actinonaias ellipsiformis
Lampsilis siliquoidea
Lampsilis ventricosa
Leptodea fragilis
Micromya iris
Proptera alata

In the Black River, a medium-sized stream, are found:

Amblema costata
Elliptio dilatatus
Fusconaia flava
Quadrula quadrula
Anodonta grandis
Anodontoides ferussacianus
Strophitus rugosus
Carunculina parva
Lampsilis siliquoidea
Lampsilis ventricosa
Leptodea fragilis
Proptera alata
Truncilla truncata

Present in the Grand River, the only large-sized stream in the county, are 24 species:

Amblema costata
Amblema peruviana
Strophitus rugosus
Actinonaias carinata
Cyclonaias tuberculata
Elliptio dilatatus
Fusconaia undata
Pleurobema cordatum coccineum
Quadrula pustulosa
Quadrula quadrula*
Alasmidonta marginata
Anodonta grandis
Lasmigona complanata*
Lasmigona costata
Lampsilis siliquoidea
Lampsilis ventricosa
Leptodea fragilis*
Leptodea laevissima
Ligumia recta latissima
Obliquaria reflexa*
Obovaria olivaria*

Proptera alata*
Truncilla truncata*
Truncilla donaciformis*

Lentic, or standing water, habitats in Ottawa County support 10 species:

Amblema costata
Amblema peruviana
Fusconaia undata
Anodonta grandis
Anodonta marginata
Lasmigona complanata
Lampsilis siliquoidea
Lampsilis ventricosa
Leptodea fragilis
Proptera alata

This Ottawa County faunal list contains 21 genera and 32 species. Specimens of these different species are not all equally common; and even the more common species must be considered less abundant than they formerly were. The serious depletion of the mussel fauna can be traced to three major factors: clamming for the pearl button industries, dredging, and pollution.

The Grand River was one of the major sites of Michigan button industries (van der Schalie, 1948), and a button factory formerly existed in Ottawa County at the village of Lamont.

Eleven species of naiades have been listed by van der Schalie (1938, 1948) as commercially valuable in the manufacture of buttons:

Amblema costata
Elliptio dilatatus (if white)
Fusconaia flava
Pleurobema cordatum coccineum
Quadrula pustulosa
Quadrula quadrula
Strophitus rugosus
Actinonaias carinata
Lampsilis siliquoidea
Lampsilis ventricosa
Ligumia recta latissima

Two species groups show intergradation between their ecologically upstream and downstream counterparts within the same genus. *Amblema costata* and *Fusconaia flava,* normally associated with upstream areas or small tributaries, have counterparts in larger streams in *A. peruviana* and *F. undata* respectively. Further investigations must be undertaken to define clearly the taxonomic status of these nominal species. *A. peruviana* may be added, for the present, to the preceding list of commercially valuable naiades, which all occur or have occured in Ottawa County in the Grand River. The most abundant mussels are *Amblema peruviana, Quadrula pustulosa* and *Actinonaias*

*Gained entry into the lower portions of the Grand River from Lake Michigan (van der Schalie, 1941).

carinata, which all have heavy shells and provide excellent button material. Published reports of large mounds of discarded valves made by the button factories act as testimony to the significance of these clamming operations in the depletion of the mussel resources and the subsequent abandonment of this industry.

The basin of the Grand River in Ottawa County has been dredged frequently in recent years to facilitate the passage of gravel ships and pleasure craft. The dredged materials are deposited on the banks. This operation destroys all the unionids captured with the substrate, and it severely damages the mussel beds.

Pollution has increased greatly in recent years. The lower portions of the Grand River carry much of the industrial waste of Grand Rapids. More recently, sodium arsenite has been used commonly to destroy aquatic algae, and this chemical is proving very harmful to the bottom fauna.

The combined effects of clamming, dredging, and pollution have greatly depleted the mussel populations of Ottawa County. If one examines the dredged materials on the banks of the Grand River, there is found a conspicuous scarcity of juvenile naiades. Moreover, most of the shells are extensively eroded. Evidently the mussel populations are not being replaced. Shells of adults of only the following three species consistently had an intact periostracum and showed no algal or mineral encrustations: *Anodonta grandis, Lasmigona complanata,* and *Leptodea fragilis.* The shells in the collections of the three most abundant species, however, were so badly weathered and eroded as to indicate that they no longer live in this portion of the drainage system.

In addition to its tributaries, the Grand River in Ottawa County contains several long, narrow bayous at right angles to the stream. More intensive collecting may well reveal living naiades which are essentially limited to these relatively unadulterated areas.

This report emphasizes a widespread trend, indicating that the native American mussel fauna is changing rapidly under the influence of human activities. With the cessation of the button industry, there has been little active interest in this mollusk group, and in the face of the alterations of natural conditions,

information bearing on the biology of naiades will become increasingly more difficult to obtain.

LITERATURE CITED

1. Coker, R. E., Shira, A.F., Clark, H. W., and Howard, A. D., 1921. Natural history and propagation of fresh-water mussels, U. S. Bur. Fish. Bull., *37*:77-181.
2. Schalie, H., van der, 1938, Hitch-hiking mussels and pearl buttons, Mich. Conserv., *7* (10) :4-5, 11.
3. —— 1941, Zoogeography of naiades in the Grand and Muskegon Rivers of Michigan as related to glacial history, Pap. Mich. Acad. Sci., Arts, Lett., *26*:297-310.
4. —— 1948, The commercially valuable mussels of the Grand River in Michigan, Mich. Dept. Conserv., Mich. Publ., *4*:3-42.

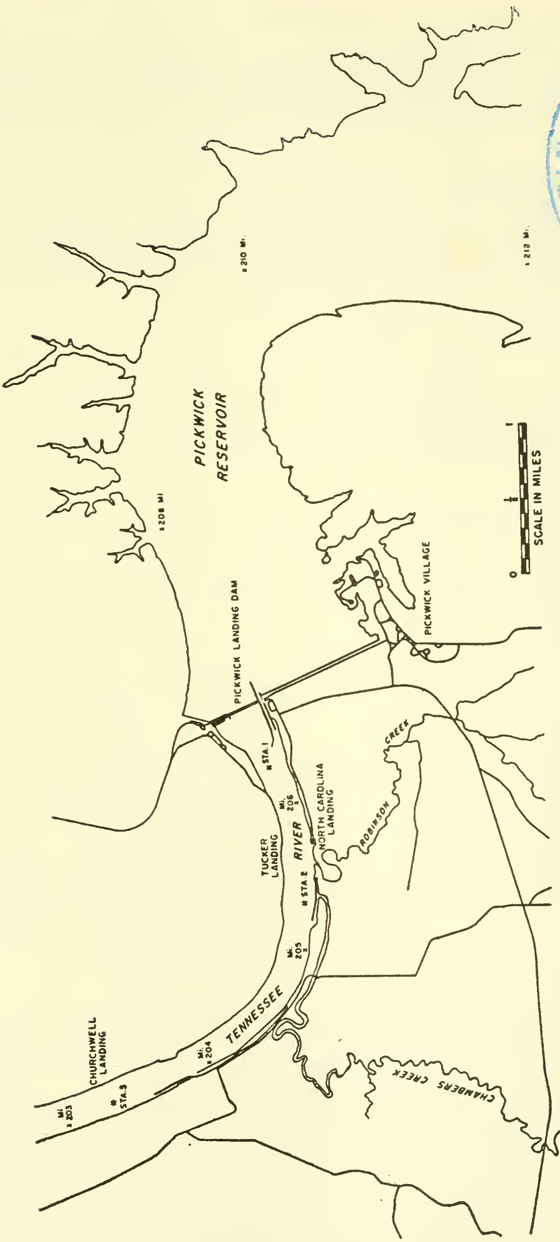
A NEW RECORD FOR THE ASIATIC CLAM IN THE UNITED STATES, THE TENNESSEE RIVER

BY RALPH M. SINCLAIR AND WILLIAM MARCUS INGRAM*

Examination of Petersen dredge samples, made by Messrs. Harold N. Mullican, Billy G. Isom, and the senior author on October 21, 1959, below Pickwick Dam, on a preliminary study to gather baseline data on Kentucky Lake, revealed large numbers of the Asiatic clam, *Corbicula fluminea* (Plate 7). Indentification was confirmed by comparison with specimens from Bonneville Dam, Oregon, which are housed in the United States National Museum. The Pickwick collections represent a remarkable extension of the range for this mollusk which was heretofore known in the United States only from collections made in western states, i.e., Arizona, California, Idaho, Nevada, Oregon, and Washington, Ingram (1948), (1959), Dundee and Dundee (1958). Ingram (1959) discussed this clam as a potential and actual pest in potable and in irrigation water supplies. One can only speculate as to the mode of transportation of this native of Asia; however, a likely theory would first incriminate the dumping of aquaria and fish bowls that contained introduced "aquaria rarities."

Station Locations. Clams were taken at three stations below Pickwick dam (mile 206.7) on the Tennessee River in Hardin

*Respectively, Principal Biologist, Stream Pollution Control, Department of Public Health, Nashville, Tennessee; and In Charge, Biological Field Investigations, Technical Services Branch, Division of Water Supply and Pollution Control, PHS., Cincinnati, Ohio.



ASIATIC CLAM COLLECTING STATIONS
TENNESSEE RIVER

TABLE I

ORGANISMS	1			2			3		
	206.3 power line			205.3			203.3		
	left	mid	right	left	mid	right	left	mid	right
Zoothamnium	F								
Dendrosoma	C								F
Spongilla fragilis								A	
Trochospongilla leidyi	C			C					
Unidentified Sponge					F			A	
Cordylophora lacustris		F		F	A	A			
Dugesia tigrina	5		2	4	4	6	14		19
Urnatella gracilis	C	C	C	C	F		F		F
Paludicella articulata	C			F	F	F	F		F
Fredericella sultana	C								
Pristina							1		
Nais communis				1		1		7	
Paranais									
Unidentified Leech									1
Unidentified Beetle			1						
Chaoborus punctipennis					1				
Hydrobaenus sp. A	31	47	5	9	117	68	1	26	4
Cricotopus bicinctus						1			
Unidentified Tendipedini								1	
Harnischia sp. A		5	2		29	2	1	8	
Tendipes nervosus	1				4	15		2	1
Tendipes modestus	59	14	16	7	12	7	1		3
Polypedilum sp. B									1
Calopsectra exigua			2	5	3	48	3	169	101
Trycorythodes	1			1			1		1
Stenonema				1					
Agraylea			2				1		
Athripsodes				2					
Potamyia flava				41		44	19	131	234
Hydropsyche orris				141		17	2	3	11
Cheumatopsyche		1		4	5	43		30	13
Psychomyiidae Genus A	51	22	21	30	54	92	11	193	21
Lithasia verrucosa									1
Ferrissia shimekii				4		33	7	5	19
Quadrula sp.						1	1		
Quadrula tuberculata						2			
Corbicula fluminea	4	1	5	11		1	77		7
TOTAL	152	90	56	261	229	381	141	575	437
	298			871			1,153		

F - few C - common A - abundant

Table 1. Benthos from Pickwick Tailwater

County, Tennessee (See map). The stations were at miles 206.3, 205.3 and 203.3; the numbers of clams taken at these respective stations were 10, 12, and 84 (Table 1). The tail water in which the three stations lie is actually the upper limit of Kentucky Lake, one of the main stream reservoirs on the Tennessee River (Plate 8).

Station 1 at mile 206.3 (See map) was bedded over large gravel and polished stone on the right bank and large limestone

boulders on the left bank, placed there to prevent erosion; flat rock was the typical substrate in the cross-section. Aquatic vegetation consisted of *Cladophora* and diatom slimes. At the time of sampling, the water was clear with a temperature of 21° C., a D.O. of 7.4 ppm, and a pH of 7.5.

Station 2 at mile 205.3 was bedded over materials similar to Station 1; here the dominant aquatic plants were mats of *Lyngbya aestuarii* and sparse clumps of *Cladophora,* with diatom slimes. The temperature was 21°C, the D.O. 7.4 ppm and the pH 7.5.

Station 3 at mile 203.3 was bedded over flat rock, with shale having been turned up in large, thin, flat pieces in mid-stream by dredging operations. The major alga was *Cladophora.* Surface water temperature was 21°C. Dissolved oxygen and pH were not taken.

Velocities at the three stations were above scouring, with small and loose materials being washed out and carried downstream. Petersen dredge hauls were made at the stream margins and at mid-channel at the three stations, a total of 9 points being dredged in all.

General Faunal Associates of Corbicula. The principal invertebrates were forms that were attached firmly to the substrate by holdfasts, such as bryozoans, sponges, and hydroids. These animals, which could not be enumerated reasonably because of their colonial nature, formed extensive mats which covered practically every rock that was picked up in Petersen dredge hauls. They were missing only from flat shale dredged up in mid-channel at Station 3. This fauna provided shelter for many of the other faunal elements.

The invertebrates taken with *Corbicula fluminea* are enumerated in Table I. Fish that are known to occur in the tail-water reach of the three stations are, particularly, sauger, yellow and channel catfish, striped bass, and gizzard shad.

Mollusk associates of Corbicula. Four species of mollusks were collected in association with *Corbicula,* two gastropods and two pelecypods. The pulmonate gastropod *Ferrissia shimekii* was taken at Stations 2 and 3. Only one specimen of the gilled snail *Lithasia verrucosa* was taken at Station 3. The two unionid clams that were collected were species of *Quadrula,* one an un-

identified species and the other *Quadrula tuberculata.*

Previously reported collections of *Corbicula fluminea* have been from substrates of sand, or mud, or a combination of the two. Those reported were found on a bottom composed of patches of stone and gravel on bedrock. With this ability to adapt to an apparent great variety of bottom types, further extension into streams of the East is likely. Of the 106 specimens taken at the three stations on the Tennessee River the largest measured 12.5 mm. and the smallest 0.9 along an anterior-posterior axis. On the average, these clams (Pl. 7, upper 2 figs.) appear to be considerably smaller in over-all length than those of this species encountered in the West (lower 2 figs.).

Acknowledgments. Grateful appreciation is expressed to Harold N. Mullican, Chief Biologist and Billy G. Isom, Senior Biologist, of Stream Pollution Control, Department of Public Health, Nashville, Tennessee, who assisted in making possible this paper through their field efforts. Appreciation is given to Drs. Harald Rehder, J. P. E. Morrison and A. C. Smith of the United States National Museum for the lending of specimens for comparative use in specimen identification. Dr. Morrison confirmed the writer's identification based upon specimens sent to him from the Tennessee River. The aërial photograph (plate 8) of Pickwick Reservoir and its tail water reach of the Tennessee River was supplied by Mr. Gene Ruhr of the Tennessee Game and Fish Commission.

References

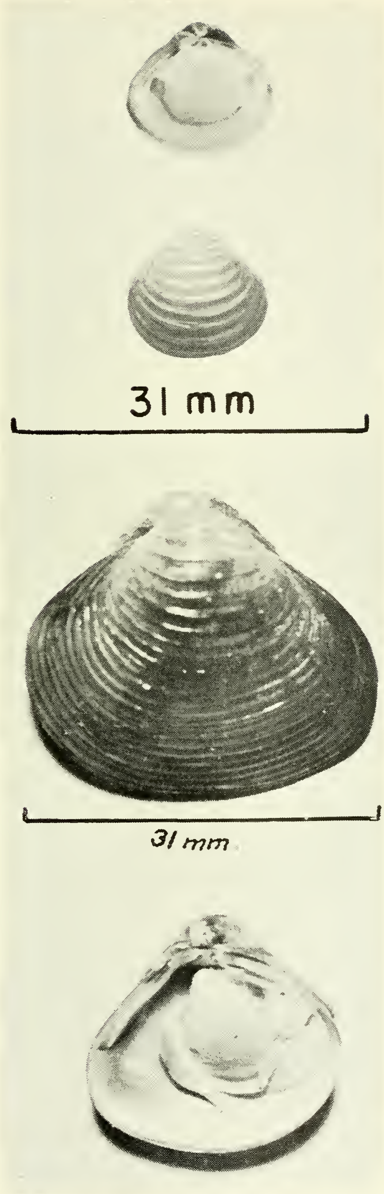
Dundee, D. S., and Dundee, H. A. 1958. Extensions of known ranges of four mollusks, Naut. *72:* 51-54.

Ingram, W. M. 1948. The larger fresh-water clams of California, Oregon, and Washington. Jour. of Entomology and Zoology, *40* (4): 72-92.

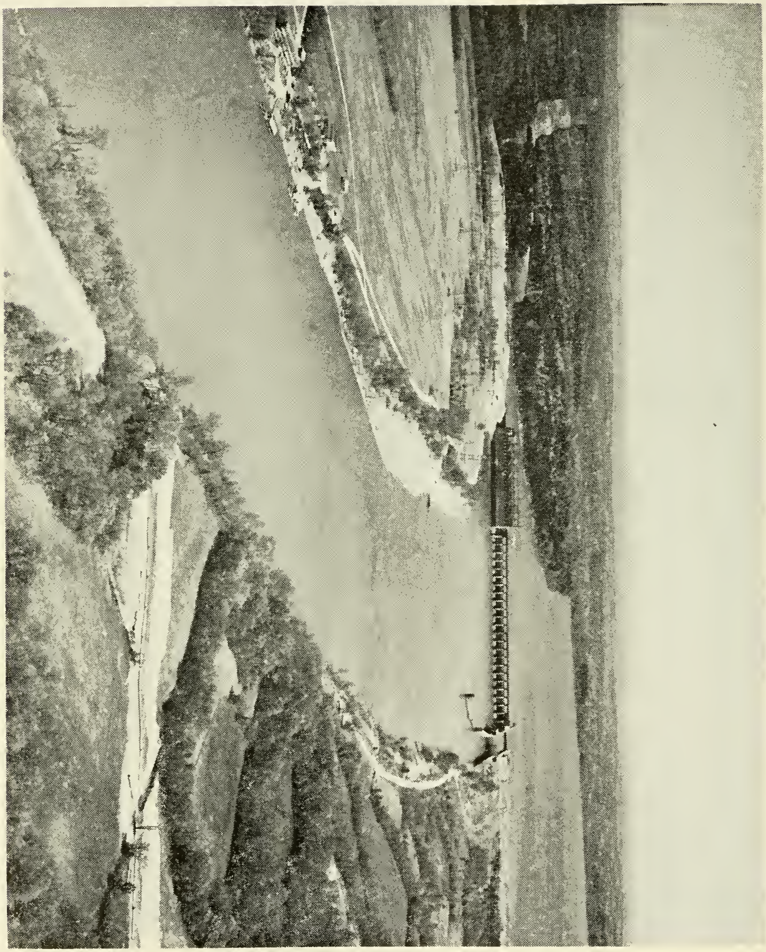
—— 1959. Asiatic clams as potential pests in California water supplies. Jour. American Water Works Association, *51* (3): 363-370.

NOTES AND NEWS

Hubert G. Schenck (1897-1960).—Professor Schenck, of Stanford University, died on June 19. His scientific interests were paleontology and stratigraphy. Schenck's research on mollusks chiefly concerns taxodont bivalves. He set very high standards



Corbicula fluminea (Mueller). Upper 2 figs. from Tennessee River, Tennessee. Lower 2 from Tracy Pumping Station, California.



both for himself and his students, and as a teacher he was outstanding. During his years in the Pacific, Schenck sent back to Stanford fine collections of shells from New Guinea, Truk, the Philippines and Japan. He was a life member of the American Malacological Union and of the Malacological Society of London.—R. Robertson.

Peter Olaus Okkelberg died Sept. 13, 1960, at Ann Arbor, Michigan. He will be remembered by members of the A.M.U. who attended the meeting 2 years before, when his wife and he were guests at the banquet. An obituary will appear later. —Henry van der Schalie

Foreign subscriptions.—Because so many foreign subscribers request receipts, postage outside the United States (except Canada) will be increased 10 cents. Thus, beginning with volume 75, foreign subscriptions will become $3.75.—Mgr.

Additional notes on discarded shells of mollusks.—Some years ago I published a brief discussion on discarded shells of food mollusks found on the intertidal zone of Cape Ann, Mass. (Naut. *57*:67-68. 1943.). Since then the same problem has come to my attention while collecting in fresh-water habitats. For example, while collecting specimens with my class in field zoology in the Cuyahoga River of northeastern Ohio, June 2, 1957, we found a valve of the marine quahog *Mercenaria mercenaria* and two shells of the land snail *Otala lactea.* These were found in debris along the banks of the river and obviously were discarded shells of food mollusks. (*M. mercenaria* is shipped inland from the Atlantic Coast and *O. lactea* is an importation from Spain and North Africa. The latter is often found in Italian markets. Shells of food mollusks become widely scattered.) A specimen of *M. mercenaria* was also collected from Tinker's Creek near Valley View, Ohio, in the spring of 1958, and another one was found on the banks of the Salt Fork River near Homer, Illinois, on March 19, 1957. From this same stream near Urbana, there was also collected on September 9, 1958, a shell of *Trigoniocardia media,* a marine bivalve from southeastern U.S. Shells of the oyster *Crassostrea virginica* are fre-

quently encountered in our inland areas as discarded shells. Two unusual marine bivalves were collected in Plum Creek in Portage County, Ohio, on September 28, 1959. These were identified as *Meretrix meretrix (L.) lusoria* (Röding) by Dr. W. J. Clench. Dr. Clench has pointed out that these shells are from Japan, being sold by the Japanese as novelties. These give rise to paper flowers which float out from between the valves when immersed in water.

Such advectitous shells seem to find their way into natural habitats. Ordinarily they can be recognized at once, although they often take one by surprise. Fortunately most of them offer no problem, but if they should become fossilized, they could at some future date be misinterpreted. Perhaps another serious situation would arise if shell collectors discard duplicates or imperfect specimens in such a way that they would be found at some future time in a natural habitat out of their normal range and lead to a misunderstanding on the part of the collector.—Ralph W. Dexter, Kent State Univ., Kent, Ohio.

Early records of Littorina littorea from the coast of Massachusetts.—The introduction and spread of the English periwinkle, *Littorina littorea,* on the Atlantic coast of North America has been the subject of much interest in past years. Gray (Science News, April 15, 1879) made the statement that, "it did not occur in the waters of Southern New England in 1871 or 1872." Morse, (Bull. Essex Inst. *12:*173-176, 1880) gives 1872 as the earliest date for records at Salem and Provincetown, and 1875 for the first record at Woods Hole. An anonymous note in the American Naturalist (*4:*250, 1870) stated that a specimen collected at Kennebunkport, Maine, was the farthest south up to that time. Ganong (Amer. Nat. *20:*931-940, 1886), reviewed the problem and compiled the earliest date of records from Halifax, in 1857, to New Haven in 1879. Subsequently, the claim was made that the first known record went back to 1840, when the species reputedly was collected at Pictou, Nova Scotia.

In the files of the Peabody Museum of Salem, there is a letter written by J. Henry Blake on July 16, 1920, to Prof. E. S. Morse, which reads as follows:[1]

[1] Thanks are due Ernest S. Dodge, Director of the Peabody Museum for permission to study the Morse Correspondence and to quote the letter included in this note.

"Regarding *Littorina littorea,* as mentioned in your paper, I have this in my notes of the Mollusca of Provincetown written in 1877:—'*Littorina littorea*—found now (1877) very abundant at Provincetown, and can be gathered by the thousands. I had never noticed a specimen either alive or dead on the shore previous to the year 1870, when I found two live specimens at a particular place where there was the ruins of an old wharf. This was in the center of the town and where cargoes of wood and lumber were unloaded from a vessel which plyed between Bangor and Provincetown for many years. On visiting this same locality the following summer I found a handful or more and a few scattering ones at other places along the shore, and so they have continued to increase in numbers until this ('77) year when I can collect a bushel of them at most any place along the shore.'— I also found the first specimen at Wood's Hole in 1875, although credit is given Prof. Verrill and, I think, justifiably so as he was in charge.—I feel almost certain this Provincetown specimen was brought to Provincetown attached to the bottom of this brig commanded by Capt. Benj. Ryder, who sailed back and forth between Bangor, Me., and Provincetown for many years."

According to this account by Blake, the species actually was introduced into Provincetown two years before the published records list it, and established an outpost there before the species was introduced at intervening points along the coast. Blake's explanation that this snail was introduced on the lumber brig from Bangor, seems very reasonable.

—Ralph W. Dexter, Kent State University, Kent, Ohio

Northwest Shell Club.—A meeting for organization was held Sept. 18, 1960, in Seattle at the home of Mr. W. Jackson Sallee. Those present elected the following officers: President, Tom Rice of Poulsbo. Vice-president, Phil Spicer of Centralia. Secretary-treasurer, Miss Joan Shields of Seattle. Another meeting was scheduled for Tacoma on November 13. Interested collectors in British Columbia, Idaho, Oregon, and Washington are invited to attend. For further information write: Tom Rice, Route 2, Box 483, Poulsbo, Washington.

Sphaerium transversum (Say) was collected from the Neosho River, 2½ miles south of Iola, Allen County, Kansas, in an unusual habitat. In the Neosho River, *S. transversum* almost always occurs in the soft mud banks and in small, quiet pools.

On August 21, 1957, 40 live adult and immature *S. transversum* were removed from between the valves of a dead *Crenodonta peruviana* (Lamarck); in addition there were approximately 30 dead *S. transversum* present. Little silt occurred in the unionid shell, and the shell was partially buried in a riffle having swift current. *S. transversum* was identified by Rev. H. B. Herrington.—Harold D. Murray, Department of Zoology, University of Kansas, Lawrence, Kansas.

Helix pomatia Linné, colonized at Plymouth, Mass.—Mr. Emmett Baker of Kingston, Mass., has brought to my attention the existence of a well established colony of this European snail in Plymouth. This colony is located in and around a garden at 27 Nelson St., an area of an acre or two. Mr. Donald Peterson, the present owner of the property, stated that a Mr. Joseph Vacchino introduced the original snails from Italy in 1928. Mr. Peterson received this information from Mr. Vacchino's son.

So far as known, this colony of *H. pomatia* is confined to this small area. The only other recorded colony of this species in North America is at Jackson, Michigan, which has been reported upon by A. F. Archer (1937, Naut. *51:* 61-63).

I visited this colony on July 11, 1960, accompanied by Mr. and Mrs. Baker and Dr. Clench. Some 20 specimens were found within an hour's search. Mr. Peterson stated that specimens were far more abundant the previous year, and also stated that they had done but little damage to his garden. As Archer has stated, they feed mainly on dead vegetation.—R. D. Turner.

A record size for Mya arenaria.—Through the kindness of Mr. Win Brooks we have received one of the largest specimens of *Mya arenaria* Linné so far recorded. The specimen was collected by Mr. Brooks on the eastern end of Phillis Island, Barnstable Harbor, Massachusetts, at extreme low water. It was dead when collected. It measures 166 mm. (about 6½ inches) in length. The next largest in length is 153 mm. (about 6 inches) from Essex, Mass. Both of these specimens exceed the largest specimen available to Richard Foster of 140 mm. from Chelsea Beach, Mass. (Johnsonia, 1946, *2:*33.—William J. Clench.

Orthalicus in the Cayman Islands.—Through the co-opera-

tion of Mr. Robert Sevier Fuller, owner of Fuller's "Shell Shack" Museum on Grand Cayman, and known to all on the island as "Bob Fuller," I have received two specimens of a species of *Orthalicus* from Grand Cayman. According to his notes, 5 specimens were found on an orange tree in the backyard of a home ½ mile from the airport. Another juvenile specimen was collected on a pepper plant.

The presence in the Cayman Islands of these shells, which exactly match specimens of *Orthalicus undatus jamaicensis* (Pilsbry) in our collection is certainly due to an introduction by man. Mr. Fuller also seems sure of this, for he says: "Most of the fruit trees [in this garden] were brought over from Hope Gardens in Jamaica, because many of the Caymanians have done that and these trees were all grafted trees."

This interesting addition to the malacological fauna of the Cayman Islands was not mentioned by Pilsbry in his papers on the land mollusks of Grand Cayman and Cayman Brac. Although its discovery on the island is of such recent date (we knew nothing of its presence there when we visited Grand Cayman in May of 1960) quite possibly further specimens will turn up in other gardens in and around Georgetown as well as in other parts of the island.—H. A. Rehder.

Pisidium henslowanum (Sheppard) in Lake Michigan.—On July 1, 1960, a single living animal of this species was dredged from Lake Michigan (5 fathoms), 3 miles south of Grand Haven, Michigan, by Dr. Alfred M. Beeton of the U.S. Fish and Wildlife Service. This is a unique discovery, because the previous westernmost record in North America was Niagara Falls, Lincoln County, Ontario (UMMZ. 198572).—William H. Heard, Museum of Zoology, Ann Arbor, Michigan.

Succinea campestris vagans Pilsbry, 1901, Naut. *14*:74—Since a museum number (ANSP. 78882) is not a valid selection of a type, and Pilsbry, 1948, Land Moll. N. A. *2*:844, did not distinguish it either in his dimensions or in his shell figs. (p. 819, fig. 443d), I now select the animal represented in his fig. 456-A as the type of *Quickella vagans* (Pilsbry), 1948, which is the originally designated type species of *Mediappendix* Pilsbry, 1948, op. cit.:843.—H. Burrington Baker.

PUBLICATIONS RECEIVED, 1959

Pages in *italics* include new taxons

Menzies, Robert J., Maurice Ewing, J. Lamar Worzel & Arthur H. Clarke, Jr. Ecology of the recent Monoplacophora. Oikos *10:*168-182, 10 figs.

Nicol, David, George A. Desborough & James R. Solliday. Paleontologic record of the primary differentiation in some major invertebrate groups. J. Washington Acad. Sci. *49:*351-366, 16 figs.

Paraense, W. Lobato & Newton Deslandes. The Brazilian species of *"Drepanotrema."* VII, *"D. petricola"* (Odhner, 1937). Rev. Brasil. Biol. *19:*319-329, figs. 1-13. The renal ridge as a reliable character for separating *Taphius glabratus* from *Taphius tenagophilus.* Amer. J. Tropic. Medic. and Hyg. 8: 456-472, figs. 1-26.

Riedel, Adolf. Additions to knowledge of Zonitidae (Gastropoda) of Soviet Armenia and adjacent lands. (Russian.) Ak. Nauk Armjanskoj SSR. Zool. sbornik *11:*191-206, 12 figs.

Rosewater, Joseph. Calvin Goodrich, a bibliography and catalogue of his species. Occ. Papers Moll., Mus. Comp. Zool. Harvard *2:*189-208, 4 figs.

Smith, Allyn G. Shells from the bird guano of southeast Farallon Island, California, with description of a new species of *Liotia.* (and G. D. Hanna.) A rare species of *Chiton* from Pioneer Seamount off central California. Proc. Calif. Acad. Sci. *27:383-387,* 389-392, pl. 20, figs. 2-4, 6, 10 & 11 & text figs. 1-3. 1952.

Turner, Ruth D. The status of systematic work in the Teredinidae. In "Marine boring and fouling organisms," Dixy Lee Ray, ed., pp. 124-136.

Valentine, James W. Pleistocene molluscan notes. 1, The Bay Point formation at its type locality. *Turritella granti,* a new Pleistocene gastropod from Palos Verdes Hills, California. J. Paleontology *33:*685-688, 1 fig.; *688-691,* 3 figs.

Venmans, L.A.W.C. Land and freshwater molluscs from the Dolomites. (Supplement).
Notes on molluscs from the Belgian Congo: 1, Genus *Streptostele* H. Dohrn, 1866. Att. 1st. Veneto Sci., Let. & Arti *117:*357-371, 3 figs. Rev. Zool. Bot. Afr. *60:31-48,* 6 figs.

Zilch, Adolf. Handb. d. Paläeozool. *6* (Gastropoda von William Wenz, Teil 2, Euthyneura, Lief. 2): 201-400, figs. 702-1434. Gebrüder Borntraeger, Berlin-Nikolassee.

Adam, William. Les céphalopodes de la mer Rouge. Miss. Robt. Ph. Dollfus en Egypte, part 28:125-192, 25 figs., 9 pls.

Benthem Jutting, W. S. S. van. Rumphius and malacology. Rumphius Memorial Vol.:181-207, photos. 17-22.—Non-marine Mollusca of the north Moluccan Islands Halmahera, Ternate, Batjan and Obi. Treubia *25:25-87,* figs. 1-3.

Habe, Tadashige. Five new minute bivalves from Japan (Erycinacea). Publ. Seto Mar. Biol. Lab. *7:291-294,* 15 figs.

Mead, Albert R. Increasing complexity in the problem of the giant African snail. J. Colo.-Wyo. Acad. Sci. 4 (11), 1 p.

Yamamoto, Gotaro & Tadashige Habe. Fauna of shell-bearing mollusks in Mutsu Bay, Lamellibranchia (2). Bull. Mar. Biol. Stat. Asamushi *9:85-122,* pls. 6-14.

1960

Adam, William. Cephalopoda from the Gulf of Aqaba. Israel Sea Fish. Res. Sta. Bull. 26:26 pp., 10 figs., 1 pl.—Notes sur le céphalopodes, 24: Contribution a la connaissance de l'hectocotyle chez les Ommastrephidae.—A propos de *Chlamys* (F. Acc. *Hinnites*) *abscondita* (P. Fischer, 1898) de la cote occidentale de l'Afrique.—Les mollusques terrestres et dulcicoles de la Belgique, quelques additions et rectifications. Bull. Inst. Roy. Sci. nat. Belgique *36* (19):10 pp.; (20):10 pp., 2 pls.; (22):10 pp., 7 figs.—Les céphalopodes de l'Institut Francais d'Afrique Noire, II. Bull. l'Inst. l'Afr. Noire *22:*465-511, figs. 1-4.

Blake, John W. Oxygen consumption of bilvalve prey and their attractiveness to the gastropod, *Urosalpinx cinerea.* Limnology & Oceanography *5:*273-280.

Burch, John B. Chromosomes of *Gyraulus circumstriatus,* a freshwater snail. Nature *186:*497-498, 1 fig.

Habe, Tadashige. Pelecypod shell remains in Tanabe Bay, Wakayama Prefecture. Rec. Oceanogr. Works Japan, Special No. 4: *39-51,* 1 fig.

Clarke, Arthur H., Jr. Mollusks collected at the surface of the Ice Island. Geophysical Research Papers, no. 63, Appendix 4.—Catalogue and illustrations of mollusks described by Wesley Newcomb, with a biographical resume. Bull. Amer. Paleont. *41:*135-160, pl. 17 & portrait.—A giant ultra-abyssal *Cocculina* from the Argentine Basin. Nat. Hist. Papers, Natl. Mus. Canada no. 7, *4 pp.,* 1 fig.—Arctic archibenthal and abyssal mollusks from drifting station Alpha. Breviora, no. 119, *17 pp.* & pl.

THE NAUTILUS

Vol. 74 April, 1961 No. 4

TEMPERATURE AND LIGHT AS FACTORS AFFECTING THE LOCOMOTOR ACTIVITY OF SLUGS

By EDWARD J. KARLIN
Bowling Green State University

Slugs, as are most snails, are primarily nocturnal animals. The exact mechanisms which initiate and terminate their nocturnal activities have been studied only superficially. Dainton (1954) published two classic papers on the subject. Although her work dealt with a series of laboratory experiments on a single species of slug, she drew apparently valid conclusions concerning the probable causes of slug activity in the field as well as in the laboratory. This paper presents observations on the activity of 3 species of slugs. *Philomycus carolinianus* (Bosc.), *Limax poirieri* Mab. (= *L. marginatus* of Pilsbry, 1948), and *Deroceras reticulatum* (Müller). These slugs were studied under a combination of laboratory conditions approximating those found in the fields, *i.e.,* with several variables in the environment. The inclusion of *D. reticulatum* as a test animal allows for comparisons to be drawn between these data and those of Dainton. *Deroceras reticulatum* was used by both researchers although the actual specimens were from the United States and Great Britain respectively.

Methods. All slugs were kept in a large glass terrarium, the bottom of which was covered with a layer of peat moss and a few rocks under which the slugs might hide. The moss was moistened regularly and kept near saturation. In addition, the tank was covered so that high humidity conditions generally prevailed and air movements were minimized. Dainton had already indicated that slugs respond to direct air currents and that asmospheric moisture presumably has no direct effect upon slug activity. However, most land mollusks of high water content respond more readily to other environmental influences.

The slug-filled terrarium was kept in a western exposure so that changes in the evening light would be readily communi-

cated to the slugs. The tank was shielded, however, so that direct sunlight never fell upon it.

Two thermometers were placed upon the surface of the peat moss to record the temperature at the point where slug activity would first be noticeable as the slugs emerged from beneath the rocks or from crevices in the peat. A slight temperature gradient probably existed in the tank but all the data which follow are based upon observations of first activity which invariably occurred at the soil surface. Thus, the temperature readings may be assumed to be reasonably accurate for the micro-climate in which the slugs were observed.

Slugs were considered to be "active" if actually moving or if both tentacles were extended, a condition which normally preceded spatial movement by a short time. This investigation was concerned with the amount of such movement and not its speed, the latter being a factor directly related to temperature.

Observations were made at approximately 20 minute intervals starting in the early evening and continuing until movement was observed in a majority of individuals of all 3 species. Incident light reaching the tank, was read in foot candles by a photometer placed on the top of the terrarium. The readings may have differed slightly from the amount of light actually reaching the surface of the peat moss but such differences were considered negligible and did not affect the relative values of the readings at all. Observations, when the available light dropped below one-half foot candle, were made with the use of a flashlight which was darkened between observations.

The Effects of Light. Dainton concluded that light played no part in controlling the daily activity of slugs. However, she observed that temporary activity was initiated by a change from darkness to light but that, after a period of light adjustment, such effects disappeared and were not related to the long-lived nightly activity of the slugs. Nevertheless, this short-lived activity, possibly initiated by even a short exposure to light, introduced a potential source of error in those data of this experiment which were obtained after dark by the use of intermittent artificial light. Therefore, only those observations which were made by natural light and at the first use of artificial light are considered here.

Table I records the amount of light present when activity was

initiated by all 3 species of slugs. It is immediately apparent that the commencement of activity by *P. carolinianus* was not related to the amount of light which was present. Particularly when food was available, *P. carolinianus* became active under a great variety of light conditions. Observations in the field confirm the fact that even bright daylight conditions seem to have little effect upon this species. Specimens of *P. carolinianus* which were attracted to sugar baits set for insects at night, were noted to remain at the baits most of the following mornings under cool, apparently desirable, temperature conditions.

Table I. Relationship between light and slug activity

Foot candles of light	Number of times that first activity occurred		
	P. carolinianus	L. poirieri	D. reticulatum
15 or more	4	0	0
12-14	3	0	0
9-11	1	0	0
6-8	2	0	0
3-5	2	0	0
1-2	3	3	0
less than 1	4	16	14

The effects of light upon the activity of *L. poirieri* and *D. reticulatum* are more difficult to interpret. There appears to be some relationship between low light intensity and first movement. In part, this is probably an accidental correlation related to the air temperature during the period of diminishing light in the evening. However, this author is of the opinion that light cannot be completely negated as an environmental factor controlling the activity of slugs. As Dainton indicated, inactive slugs are usually concealed in such a manner that they frequently are not able to discern changes in the light intensity surrounding their darkened places of concealment. However, once activity has been initiated in response to some other factor, slugs which are emerging from concealment, may become inactive upon exposure to daylight of a particularly strong range of intensity. Dainton opposed this hypothesis and argued that the occasional observations of active slugs after daytime rains and on very cloudy days indicated that light is not a deterrent to activity. Nevertheless, personal field experiences of this writer suggest that a combination of environmental factors, including light, may be involved

in controlling activity. Large numbers of *D. reticulatum* were observed in a cornfield in central New York State where they were producing serious economic losses. No vegetation was present between the young corn plants and the slugs were concealed beneath clods of earth exposed directly to the sun's heat and light. According to Dainton, these slugs should have become active on cloudy or rain days when the air temperature was falling beneath 21°C., a figure arrived at during her laboratory experiments. In actuality, although the prescribed temperature conditions were met on several occasions, activity was not initiated except in those slugs which had been driven out of their places of concealment by flooding and even this activity soon ceased. The lack of vegetation between the rows of corn greatly diminished any effects of temperature gradients in the slugs' microhabitat, thus lending weight to the hypothesis that daylight might have had a limiting effect upon activity since inactivity as a result of temperature variation was eliminated.

When slugs are active after a rain, the attraction of food, reinforced by the odors of wet vegetation, may counteract any negative reactions to light so that activity might still result. The importance of food as an attractant has already been suggested in the discussion of *P. carolinianus* observed at insect baits.

The Effects of Temperature. Table II indicates the temperatures at which slug activity was first noticed. Where activity was noted at the time of the first observation of the evening, the data have not been included since activity may have been initiated at a still higher temperature than that recorded.

Table II. Relationship between temperature and slug activity

temperature in	Number of times that first activity occurred		
degrees C.	P. carolinianus	L. poirieri	D. reticulatum
25.0	1	0	0
24.5	1	0	0
24.0	1	1	0
23.5	1	3	1
23.0	5	4	4
22.5	2	4	2
22.0	2	3	2
21.5	1	2	2
21.0	0	3	3
20.5	0	0	0
20.0	0	1	1

A possible inaccuracy in the data of Table II may have resulted from the uncontrolled rate at which the temperature fell. Most of the observations, made at approximate 20 minute intervals, indicated a drop of less than 1°C. since the previous reading. Occasionally, no temperature change occurred between observations and, infrequently, a drop of slightly more than 1°C. was noted. Particularly in the latter case, movement may have been initiated at any time within the interval and the exact temperature at which activity commenced is unknown. At first examination, one may see that movement was initiated over a range of temperatures but within limits which differed by only 5°C. Averaging the data in Table II, one finds that movement of *P. carolinianus* was initiated at 23°C., that of *L. poirieri* at 22.5°C. and that of *D. reticulatum* at 22°C. This last figure agrees closely with that obtained by Dainton in her laboratory experiments on *D. reticulatum* under carefully controlled constant temperatures, the single degree of variation being attributable to the use of average figures in this experiment. Thus, it may be concluded that the movements of those species of slugs investigated are initiated by temperature changes above or below the specific temperatures just presented. Falling temperatures promote slug activities away from their hiding places while rising temperatures promote movements into less exposed situations where temperatures would be lower. This line of reasoning satisfactorily explains most observations of slug activity in the field. However, the writer has noted unusual situations, such as in greenhouses, where the artificially-produced environmental conditions differed from those normally expected and where slug behavior may be, to a great extent, unpredictable. Inherent individual variation and other environmental influences such as food, light and the activity of neighboring slugs, apparently all combine, in nature, to modify the exact temperature within a small range of temperatures at which initial slug activity occurs.

Note that all the observations made here pertain to large, presumably adult slugs. Karlin (1957) indicated that newly hatched slugs were active and fed during daylight hours. Small slugs frequently were observed on the glass walls of the terrarium used in this experiment. They often were surrounded by conspicuous drops of condensed moisture and were undoubtedly

living in a different microenvironment than the adult slugs which rested on or beneath the peat moss surface. It is likely that these immature slugs were also responding to temperature but that the cooling effects of direct evaporation and the need for a relatively continuous intake of food were influencing their activity as well.

It may be concluded that fluctuating temperature is the major factor controlling slug activity. However, the age and size of the slugs as well as the additional environmental factors of food supply, air movements, humidity, free moisture and incident light are all involved. The interplay of all these factors determines the activity of slugs in nature, under conditions which cannot be completely duplicated in any laboratory experiment.

Summary

Fluctuating temperature was shown to be the major factor promoting the locomotor activity of three species of slugs. Movement of *Philomycus carolinianus* was initiated at an average temperature of 23°C. while movements of *Limax poirieri* and *Deroceras reticulatum* were noted at 22.5° and 22°C. respectively. The latter figure differs by 1° from that obtained by Dainton in her studies of British slugs.

Young slugs did not respond in the same manner as did adult individuals.

Diminishing light apparently did not have any initiating effect upon the activity of the slugs. Light may restrict slug movements which are stimulated by temperature fluctuations.

Casual observations indicate that the presence of food in the environment also may influence the exact moment at which nocturnal activity commences.

References

Dainton, Barbara. 1954. The activity of slugs. I The induction of activity by changing temperatures. J. Exp. Biol. 31: 165-187. II The effects of light and air currents. J. Exp. Biol. 31: 188-197.

Karlin, E. J. 1957. A survey of the Mollusca of greenhouses in New York State with emphasis on ecology, biology and control. Unpublished thesis, Cornell University.

Pilsbry, H. A. 1948. Land Mollusca of North America. Monogr. Acad. Nat. Sci., Phila. Vol. 2, pt. 2: 521-1113.

A SECOND WESTERN ATLANTIC RISSOELLA AND A LIST OF THE SPECIES IN THE RISSOELLIDAE

By ROBERT ROBERTSON
Assistant Curator of Mollusks,
Academy of Natural Sciences of Philadelphia

The taxonomy of West Indian marine mollusks has been studied for many years and much has been published on this subject. Nevertheless, the minute species in the shallow water West Indian fauna are far less known than the larger species, and unnamed minute species are still encountered not infrequently. One of the purposes of this paper is to draw attention to this fact in the hope that those who collect mollusks in the tropical Western Atlantic will henceforth devote special attention to minute species. A method of collecting minute mollusks alive is described elsewhere (Robertson, in press). Minute species collected alive are much more useful for study than those obtained from sand or beach drift, the shells of which generally are worn or broken.

The first western Atlantic species in the family Rissoellidae was described by Rehder in 1943. *Rissoella caribaea* was collected by Dr. Blenn R. Bales in the Florida Keys. Records published in the present paper extend the known range of this species to Puerto Rico. The shell is refigured and illustrations are presented for the first time of its operculum and radula. In addition, the variation and habitats of *R. caribaea* are discussed. I have collected a tiny, second species of *Rissoella* in the Bahama Islands; this species is described and named *R. galba* in this paper.

All the species in the genus *Rissoella* are minute. The shell of *R. caribaea* attains 1.7 (.07 in.) in length; that of *R. galba* (the smallest known species in the genus) is only 0.7 mm. in length. The shell of *Rissoella* is glass-like: fragile and partially or almost wholly transparent. Probably because of their fragility, *Rissoella* shells are rare in beach drift and no fossil species in the Rissoellidae have been reported. Old, empty *Rissoella* shells are opaque, white, and readily crumble to pieces. Most species of *Rissoella* live among algae.

A live *Rissoella* is distinctive because there is a pair of tentacle-like processes anterior and median to the true tentacles. The animal thus appears to have four tentacles and is unique among

prosobranchs in this respect. (The anterior processes are either the lobes of a bifid snout—'labial palps'—or the anterior lobes of bifid tentacles.) The body is clearly visible through the shell and in some species there are characteristic spots or patterns on the mantle.

The anatomy and life history of two British species of *Rissoella* have been studied by Fretter (1948). They both are annual, and few adults survive the winter. Both species are simultaneous hermaphrodites and neither has a pelagic larval stage (see also Lebour, 1936). Neither species has a functional gill (ctenidium). One of the species feeds on diatoms, small algal filaments and detritus but both species lack a crystalline style.

The biological peculiarities of the two British species of *Rissoella* were originally attributed by Fretter to their small size. Later, however, Fretter & Graham (1954) have considered *Rissoella* to be an opisthobranch rather than a prosobranch. Later still (1956), Fretter appears to have had doubts and has again referred to *Rissoella* as a prosobranch. *Rissoella* has invariably been placed among the prosobranchs by all other malacologists (but see Clark, 1855, and Lebour, 1936). Thiele (1929) tentatively placed the Rissoellidae in the prosobranch "Stirps" (superfamily) Rissoacea between the "Trachysmatidae" (Trachysmidae) and the Choristidae, two families the relationships of which are also in doubt.

A *Rissoella* operculum is corneous and translucent. It conforms to the shape of the aperture of the shell and has a peg, which, when the body is withdrawing into the shell, acts as a pivot against the columella as well as a point of insertion of muscles. There is a buttress supporting the peg on the inner surface which in some species supposedly extends as a ridge nearly as far as the outer edge of the operculum. There is also another ridge on the inner surface which parallels the columella edge of the operculum. The peg projects from this ridge. (The peg is apparently absent in *Heterorissoa*.) The published figures of the operculum of *R. diaphana* (Alder), the type species of *Rissoella*, are inaccurate. The operculum of *R. caribaea* (pl. 9, figs. 3-5) closely resembles that of *R. diaphana*.

Thiele studied the radulae of 7 species of *Rissoella*. He discovered that there are remarkable differences between the radulae

of several species, despite the close similarity of their shells and opercula. Accordingly, he divided the genus into 5 genera and subgenera, primarily on the basis of radula characters. Later (1929), Thiele ranked these as 4 subgenera.

The radula of *R. caribaea* (pl. 9, fig. 6), the type species of the subgenus *Phycodrosus* Rehder (1943a), resembles that of *R. zebra* Thiele, the type species of the subgenus *Jeffreysilla* Thiele (1925). The radulae of both species have broad central teeth which are medially indented on the posterior margin. The laterals of both species are fairly large and the marginals are rod-like. The radula of *R. caribaea* apparently differs from that of *R. zebra* in having narrow, untoothed cusps on the central teeth. The differences between the shells of *R. zebra* (from East Africa) and *R. caribaea* are minor. In view of these similarities, *Phycodrosus* is here synonymized with *Jeffreysilla.*

There are 7 nomenclaturally valid generic and subgeneric names in the family Rissoellidae. *Jeffreysiella* and *Jeffreysilla* were originally distinguished from *Rissoella,* s.s. (and *Jeffreysiopsis),* solely on the basis of radula and jaw characters. *Jeffreysina* was distinguished by radula characters and the outline of the shell, *Phycodrosus* by minor shell characters, and *Heterorissoa* solely by a supposed difference of the operculum. *Heterorissoa* is probably indistinguishable from *Jeffreysiella,* and *Phycodrosus* from *Jeffreysilla.* I recognize only the genus *Rissoella* in the family at this time, believing that the 4 supposedly distinct subgenera very well may not be natural groups.

The distribution of the species of *Rissoella* so far described is peculiar. Excluding species which may not belong in the genus, 3 species are known from Europe, 1 from St. Helena, 3 (?) from South Africa, 1 from East Africa, 4 from islands in the S. Indian Ocean, 1 from Australia, 1 from the Kermadec Islands, 7 (?) from the Eastern Pacific, and 2 from the Western Atlantic. Undoubtedly, species in the genus remain to be discovered in these and other regions. Nevertheless, the occurrence of 6 of the 23 known species at isolated islands in the Southern Hemisphere is noteworthy.

I prefer to use the names *Rissoella* and Rissoellidae rather than *Jeffreysia* and Jeffreysiidae for the reasons given by Iredale (1915) and Bartsch (1920).

Acknowledgments. Most of the Bahamian specimens for this study were collected during 2 visits to the Lerner Marine Laboratory, Bimini. I am indebted to the Laboratory for these opportunities and to Mrs. Germaine L. Warmke, who obtained all the Puerto Rican specimens.

Family RISSOELLIDAE Gray (1850)

["Heterophrosynidae" Clark (1855), in part; "Jeffreysiadae" Carpenter (1856)]

Genus *Rissoella* Gray (1847)

RISSOELLA CARIBAEA Rehder (1943a). Plate 9, figs. 2-7.

The shells of most Bahamian specimens are slightly wider and more inflated than those of topotypes which I have examined (U.S.N.M. 537900; A.N.S.P. 179254, 221931; M.C.Z. 124167, etc.). There is much variation, however, and a few Bahamian shells are narrower than the topotypes.

When this species is alive it can be recognized by the four 'tentacles' and the black body which is clearly visible through the semi-transparent shell. In the Bahama Islands the body is black with a cream-colored pattern on the mantle inside the abapertural side of the last whorl (pl. 9, fig. 7). Curiously, most of the Floridian specimens and all the Puerto Rican specimens lack this cream-colored pattern; the bodies are uniformly black. At the type locality in the Florida Keys, *R. caribaea* has been reported to have "white tentacles contrasting strongly with the black body . . ." (Rehder, 1943b). Bahamian specimens have dark gray tentacles and anterior processes.

In the Bahama Islands this species lives intertidally among the red alga *Bostrychia ("Amphibia")* on mangrove prop roots and pneumatophores (see Robertson, 1960). The Puerto Rican specimens were obtained alive by Mrs. Germaine L. Warmke from green algae (*Caulerpa, Bryopsis, Cladophoropsis*), a brown alga (*Dictyota*), and from red algae (*Laurencia, Galaxaura, Acanthophora*). She also obtained 3 living ones from algae (probably *Bostrychia)* on mangrove roots. All but one specimen which I collected in the Florida Keys were in *Bostrychia* on mangrove roots. (The one specimen, from Knight Key, was living in the green alga *Cladophora.)* At the type locality in the Florida Keys, *R. caribaea* was found in a different habitat: "in sparsely populated colonies on the clean rocks . . ." in "an artificial fill . . . in

clean water, free from marl." (Rehder, 1943b).

I interpret the shell and body color differences as attributes of a variable species which has developed minor local forms and which has different habitat tolerances in different areas. The shape and color differences could be due to the habitat differences and to the effects of isolation. (The species possibly lacks a pelagic larval stage.) Body color variation in another species of *Rissoella* is discussed by Fretter (1948).

This species was first reported from the Bahama Islands by McGinty (1948, mimeogr.), who collected it at South Cat Cay (near Bimini), Pigeon Cays (Andros), 4-6 fathoms off Nassau Harbour (alive) and at Clifton Point (both New Providence).

New locality records: Florida Keys: Cudjoe Bay, Cudjoe Key; nr. north end Big Pine Key; Fla. Bay side Little Duck Key; Fla. Bay side Knight Key; Fla. Bay side west end Lower Matecumbe Key (all collected by author, A.N.S.P.); Missouri Key (Bales, M.C.Z.; McGinty). Florida: Venetian Causeway, on rocks (McGinty). *Bahama Islands:* Bimini (numerous localities, M.C.Z., A.N.S.P., etc.); west end Hog Cay, Exuma Cays (A.N.S.P. & U.S.N.M.). *Puerto Rico (Western):* Pta. Arenas, near Mayagüez, and Bahia Fosforescente and Cayo Enrique, both near La Parguera (all Warmke, A.N.S.P.).

RISSOELLA GALBA, new species. Plate 9, fig. 1.

Description. Shell minute, ovate, umbilicate, thin, semi-transparent; whorls $3\frac{1}{2}$, evenly rounded, inflated; fine axial growth lines on the otherwise smooth and shiny surface; an opaque white spiral band extending (in adults) around the umbilical region on the apertural side of the shell; sutures slightly impressed; aperture pyriform-ovate; outer lip thin; callus on columella in adults; umbilicus fairly narrow but adjacent shelf wide; columellar callus raised to form a ridge next to the umbilical shelf. Operculum apparently similar to that of *R. caribaea.* Whole body of animal pale yellow (changing to pale yellowish green in alcohol) except for black eyes and pale brown digestive gland and gonad. Anterior margin of foot slightly bilobed; pair of processes anterior and median to tentacles.

Measurements.	length	width	(all ±0.02 mm.)
(large)	0.68	0.56	Hog Cay, Exuma Cays
	0.66	0.52	Holotype
(young)	0.39	0.37	Cavelle Pond, S. Bimini

Specimens examined. Holotype (M.C.Z. 221105) and 2 paratypes (M.C.Z. 221106) from turf of filamentous green algae (*Cladophora?*) on rocks at low tide mark, northwest end of South Bimini, Bahama Islands. Other paratypes from the red alga

Bostrychia on mangrove roots, Tokas Cay (A.M.N.H. 84892) and Cavelle Pond, South Bimini (A.N.S.P. 252671 & U.S.N.M. 613497) [0.6 and 1.1 miles from type locality, respectively]. Additional specimens from algae on mangrove roots at west end Hog Cay, Exuma Cays, and sand from Green Turtle Cay, Great Abaco, both Bahama Islands (both A.N.S.P.). All specimens collected by the author. Pigeon Cays, Andros, Bahama Islands, with *R. caribaea* in algae (McGinty).

Remarks. This species differs from *R. caribaea* in having a smaller shell (less than half the length of *R. caribaea* when full-grown) with a slightly different outline. There is a white band on the shell which is not present in *R. caribaea* and the umbilical shelf is wider and shorter. The predominant color of the body of the two species also differs consistently; that of *R. caribaea* is black, while that of *R. galba* is pale yellow. Juveniles of *R. caribaea* much smaller than any of the specimens of *R. galba* were seen to have black bodies.

R. galba does not closely resemble any of the Eastern Pacific species so far described (Bartsch, 1920, 1927; Baker, Hanna & Strong, 1930; Strong, 1938; Smith & Gordon, 1948). Its small size and white band on the shell distinguish it from all other described species of *Rissoella.* The four 'tentacles' were seen, so *R. galba* is definitely a *Rissoella.* It is not juvenile because there are 3½ whorls; most species of *Rissoella* have 3-4 whorls.

As stated above, *R. galba* was found in the same habitat as that in which *R. caribaea* apparently invariably lives in the Bahama Islands, namely in *Bostrychia* on mangrove roots. Three specimens of *R. galba* were also found in filamentous green algae. *R. caribaea* is much more abundant at Bimini and Exuma (Bahamas) than *R. galba*: only 12 specimens of *R. galba* were collected while hundreds of *R. caribaea* were obtained.

Derivation of name. Latin, galbus, yellow (referring to the predominant color of the body).

(To be continued)

COLUBRARIIDAE (GASTROPODA) OF TROPICAL WEST AMERICA, WITH A NEW SPECIES

By G. BRUCE CAMPBELL

In August, 1960, the 105-foot shrimp trawler, "Ariel," dredged 6 days off Cabo Haro, Mexico, and southeastern Baja-Lower Calif.

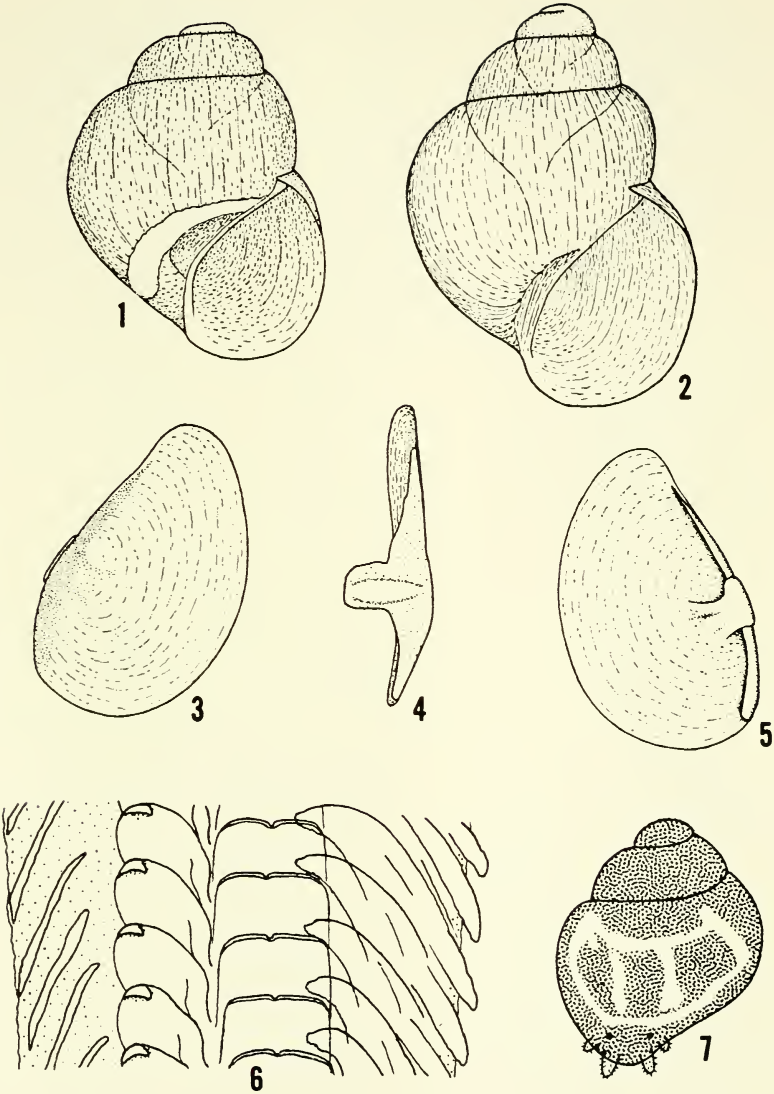
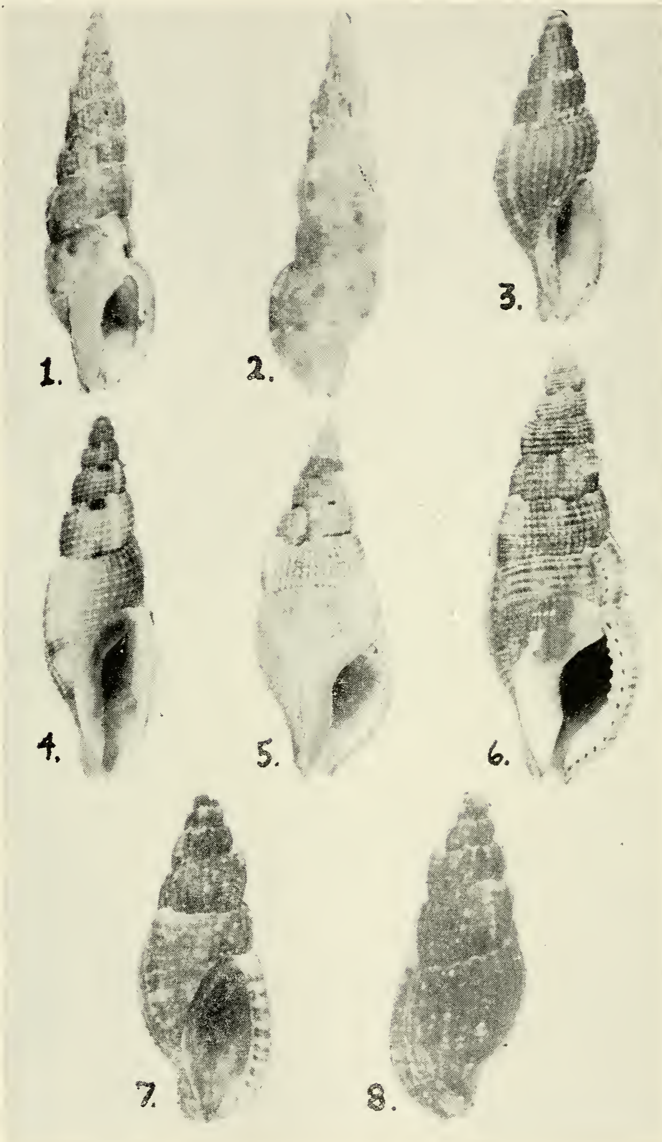


Fig. 1. *Rissoella galba* Robertson. Holotype, X60. Figs. 2-7. *Rissoella caribaea* Rehder, Bimini, Bahama Islands. 2. Shell, X34. 3. Exterior of operculum. 4. Side (columellar) view of same 5. Interior of same. 3-5, all X65. 6. Radula, X867. 7. Dorsal view of live animal, ca. X30. R.R. del.



Figs. 1 & 2, *Colubraria jordani* Strong, holotype. 3, *C. aphrogenia* Pilsbry & Lowe, holotype, ANSP. 155341. 4, *C. siphonata* (Reeve), Perlas Islands, Panama; Burch collection. 5, *C. lucasensis* Strong & Hertlein, holotype, C.A.S. 6995. *C. soverbii* (Reeve), 100 fathoms, Cabo Haro, Guayamas, Mexico; Donald Shasky coll. 7 & 8, *C. xavieri* Campbell, holotype.

She was chartered and specially outfitted by Dr. Donald Shasky and Captain Xavier Mendoza. Aboard were 21 passengers, including John Q. Burch, Dr. Antonio Garcia from the University of Mexico, and Dr. Myra Keen. Three species of *Colubraria* were obtained on this trip. The purpose of this paper is to suggest the number of valid species found in tropical west America, determine the appropriate synonymy, and enumerate the problems encountered and their most likely solution. No attempt is made to evaluate other species of Colubrariidae, except where they have been confused with or reported from the Panamic area.

Appreciation is expressed to The Academy of Natural Science of Philadelphia through Dr. R. Tucker Abbott for the loan of 6 lots of *Colubraria* including Pilsbry and Lowe's holotype, and to the San Diego Museum of Natural History through Mr. E. P. Chace for the opportunity to study the Lowe collection; to John Q. and Rose Burch for the use of their library and pertinent material; to Gale Sphon, Jr. and Dr. Donald Shasky for the loan of specimens; to Dr. Myra Keen for her suggestions and critical reading of the manuscript, and the Department of Geology of Stanford University for study material; also to the California Academy of Sciences, through Drs. G. D. Hanna and L. G. Hertlein for advice and types to study, and to Mr. S. P. Dance and the British Museum.

COLUBRARIA Schumacher, 1817

COLUBRARIA JORDANI Strong, 1938. Pl. 10, fig. 1, 2; text—fig. 1

Epidromus nitidulus (Sowerby). Strong and Hanna, 1930, Proc. Cal. Acad. Sci., (4) *19* (2): 11. list (not *Triton nitidulus* Sowerby).

"*Colubraria jordani* Strong (MS)." Hertlein, 1937, Proc. Amer. Philos. Soc. *78* (2): 306. Nomen nudum. *C. jordani* Strong, 1938, Proc. Cal. Acad. Sci. (4) *23*: 212, pl. 16, fig. 8.

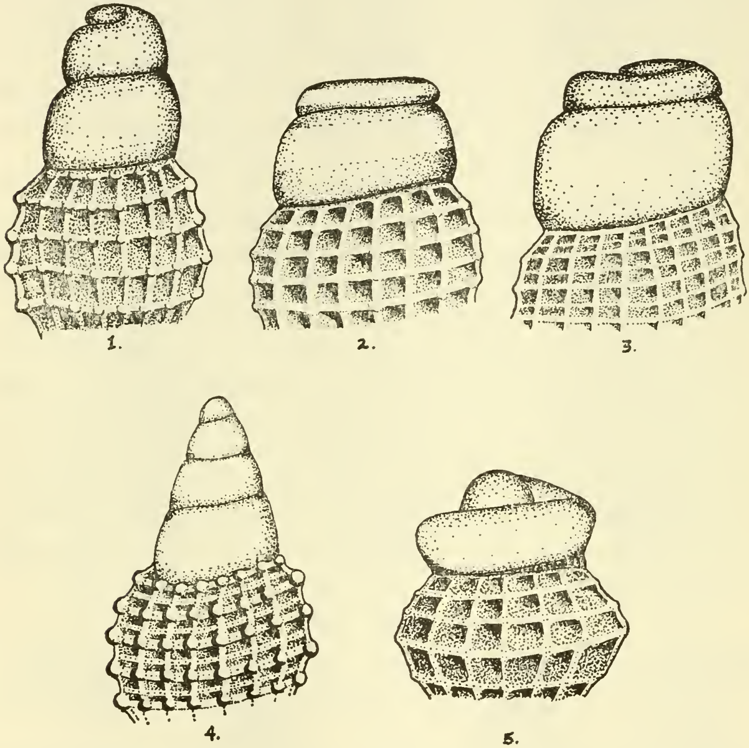
Description: Most slender of the Panamic *Colubraria,* this species is light brown with two spiral rows of darker spots, the 2½ whorls of the protoconch are followed by 11 subsequent whorls, each with 3 or 4 spiral threads crossed by equally fine axial riblets and 1 or 2 varices; base short, rounded; canal short, recurved. Length 35 mm., maximum width, 10 mm.

Type: Holotype no. 7017, Calif. Acad. Sci. Paleo. Type Coll. *Type locality*: Socorro Island, Revillagigedo group, Mexico, G. D. Hanna and E. K. Jordan, collectors, July 1925. Seven additional specimens were secured at the same locality. This species was compared with and differs from *Colubraria nitidulus* (Sow-

erby), in being decidedly more slender, having more rounded whorls, and in the more emphatic sculpture.

COLUBRARIA SIPHONATA (Reeve, 1844). Pl. 10, figs. 3, 4; text—fig. 2

Triton siphonatus Reeve. Conch. Icon. Reeve, June 1844, pl. 18 no. 81.



Protoconchs of *Colubraria*. 1, *C. jordani* Strong, holotype. 2, *C. aphrogenia* Pilsbry & Lowe, holotype, ANSP. 155341. 3, *C. lanceolata* (Menke), Destin, Floria, ANSP. 194131. 4, *C. lucasensis* Strong & Hertlein, holotype, Cal. Acad. Sci. 6995. 5, *C. reticulata* (Blainville), Italy, ANSP. 37063.

C. aphrogenia Pilsbry and Lowe. Proc. Acad. Nat. Sci. Phil. *84*: 62, pl. 4, fig. 10.

C. perla M. Smith. *Naut. 61*:55, pl. 2 fig. 2.

C. panamensis M. Smith. Naut. *61*:55, pl. 2, fig. 6.

Description: The slender, fusiform shell is dark bluish gray to light brown spotted with orange brown on whorls and whitish areas on the varices; the 2 whorls of the protoconch are dark purple to light gray in the middle and are followed by 6 subsequent, convex whorls with 8 to 10 spiral cords intersected by narrow axial ribs to form a reticulate pattern; varices, small,

irregularly spaced, about 2 per whorl; the aperture is narrow, contracted into a canal anteriorly; lip finely denticulate.
Types: Lectotype, British Museum (Natural History). Type locality: The type locality should be designated as Panama Bay, Panama. Locality records: 12 specimens, Carmen Is., Gulf of Calif., 25 fathoms; 4 specimens, Cabo Haro, Guaymas, Mexico, 50-100 fathoms, Ariel expedition, August, 1960.

M. Smith describes *Colubraria perla* as similiar to *C. panamensis,* but with the inner wall of aperture much more bent than in *C. panamensis.* Dr. Myra Keen, 1958, correctly placed *C. perla* in synonymy with *C. panamensis.*

Available for study were the holotype and a paratype of *Colubraria aphrogenia* Pilsbry and Lowe, a lot of 16 specimens of *C. panamensis* Smith, which Dr. Myra Keen stated was a portion of the original group of shells collected by Clark in Panama Bay from which Maxwell Smith undoubtedly selected his shells for description,[1] 2 specimens labeled *C. siphonata* (Reeve) collected by Clark from the Perlas Islands, Panama, a single shell in the Burch collection from the Perlas Islands, Panama with a label reading "*C. siphonatus = perla = panamensis,*" and 16 specimens of this group from several collecting stations in the Gulf of California.

Close scrutiny of the protoconch and of the other shell characteristics shows that all these shells should be considered one species. A word should be mentioned about the holotype of *Colubraria aphrogenia* Pilsbry and Lowe. It is a dead shell and less than half the adult size. Several of the smaller shells of a lot in this group in the writer's collection match perfectly the holotype. As with other groups of shells there is some variation in size, shape, and coloration.

Keen (1958, p. 348) states that the name *C. siphonata* (Reeve) will have priority for the Panamic form if it is not recognized in some other province. After reviewing both current and past literature, the writer's opinion is that a shell answering to the picture and description of *C. siphonata* (Reeve) in Conchologia Iconica, Reeve, June 1844, plate 18, number 81, has been found in no other province except tropical west America. The shells from tropical west America agree with both the picture and the description of *C. siphonata* in the Conchologia

[1] Keen, A. Myra. (Personal communication), Nov. 9, 1960.

Iconica. Tryon suggested that *C. siphonata* (Reeve) would prove to be a young *C. lanceolata* (Menke), a shell found in the West Indies. In the Conchologia Iconica, Reeve pictures both species and distinguishes between them. *Colubraria siphonata* (Reeve) can be differentiated from *C. lanceolata* (Menke) in that the protoconch is flat, bluish-gray in the middle of the whorl, shading to black at the sutures, whereas *C. lanceolata* (Menke) has a brownish-orange slightly rounded protoconch (text—fig. 3).

COLUBRARIA SOVERBII (Reeve, 1844). Pl. 10, figs. 5, 6; text-fig. 4.

Triton reticulatus Sowerby, 1833, Proc. Zool. Soc. London: 72. (not *Tritonium reticulatum* Blainville, 1829, now in *Colubraria*.)

Triton soverbii Reeve. June, 1844, Conch. Icon. Reeve., pl. 16, no. 65, a and b.

Colubraria lucasensis Strong and Hertlein, 1937, Proc. Cal. Acad. Sci. (4) *22* (6): 173, pl. 35, fig. 17.

Description: Shell rather slender, thick, and solid, generally orange-brown, spotted or streaked with darker and lighter color; the 3 whorls of the conical protoconch are orange followed by 8 sculptured whorls, each with a strong varix; sculpture of fine axial riblets crossed by equally fine spiral threads forming small rows of granules between which are brown excavated lines encircling the shell; inside the lip are 12 small denticles; aperture, oval with a short, reflected canal. Length 43 mm., maximum width 16 mm.

Type: Location not known. Type locality: The Galapagos Islands should be designated as the type locality. Locality records: 1 living specimen, Cabo Haro, Guaymas, Mexico, 100 fathoms; 1 specimen, Monserrate Is., Gulf of Calif., 45 fathoms, Ariel expedition, August, 1960.

In Strong and Hertlein's description of *Colubraria lucasensis,* they stated that it resembled the figure of *Triton soverbii* Reeve, but did not have the brown excavated lines, and that the single type specimen was not fully mature and might develop similar characters with 2 or 3 more whorls. The 43 mm. live specimen taken at Cabo Haro, Guaymas, agrees very well with the picture of *Triton soverbii* Reeve and displays the fine brown excavated lines. In addition to these shells, the writer was able to study 7 lots of *Colubraria* from the Galapagos Islands. 4 lots were labeled *C. reticulata* (Blainville), one *C. lucasensis* Hertlein and Strong, and 2 had not been named. These proved to be almost identical with the holotype of *C. lucasensis* Hertlein and Strong, and the protoconchs were the same. To comply with the rules of nomen-

clature, the name, *Colubraria soverbii* (Reeve), must be adopted.

Reeve gives the type locality for *Colubraria soverbii* as the Galapagos Islands, and said that he was renaming the shell that Sowerby described as *Triton lineatus* (preoccupied by Broderip). Sowerby's description of *T. lineatus* was one of a group of 7 new names for shells that had previously been confused with *T. maculosus* Lamarck, and he separated out these 7 as new species. Of these 7 the only one from the Galapagos Islands was *T. reticulatus* Sowerby, but he placed it under *T. reticulatum* (Blainville). The description of *T. reticulatus* Sowerby fits the picture of *T. soverbii* Reeve and Reeve's description much better than does that of *T. lineatus* Sowerby. Quite probably Reeve had the type of *T. reticulatus* Sowerby and not that of *T. lineatus* Sowerby before him when he named *T. soverbii.*

Colubraria reticulata (Blainville) has been reported on occasion from the Galapagos Islands, probably because the Galapagos Islands were incorrectly listed by Reeve as one of its habitats. Several lots of the true *C. reticulata* (Blainville), from the Mediterranean were available for comparison. The sculpture of *C. reticulata* (Blainville) is finely reticulate and the protoconch begins as a sphere and develops into a "crown," (text—fig. 5), whereas the sculpture of *C. soverbii* (Reeve) is beaded and the protoconch conical.

COLUBRARIA XAVIERI new species. Pl. 10, fig. 7, 8

Description: Shell rather slender, solid, and thick with 6 coarsely sculptured body whorls, the protoconch being absent. Each whorl has approximately two varices. General color medium brown with some indistinct lighter and darker areas; varix light tan with 12 dark brown streaks grouped mainly in pairs that blend into the solid brown of the body whorl. These brown lines end as small dots in the aperture and correspond to the twelve denticles just inside the lip. Inside of the elongate aperture pale brownish-purple bounded by a 2.5 mm. reflected canal anteriorly and a small internal notch posteriorly. The narrow aperture equals ⅔ the length. The outer lip is thickened by a varix and the body has a 3 mm. thin wash of callus with 2 shallow grooves 2 mm. apart on the columella, each bounded posteriorly by a small denticle; the sculptured whorls are of 18 to 20 coarse nodulous axial ribs crossed by fourteen less prominent spiral ridges, between which are 2 to 4 spiral threads; the upper whorls are sculptured by 6 to 8 spiral cords with 2 to 3 spiral threads between and about 14 sharp, straight, axial ribs. The type

measures: Length 26.5 mm., maximum width 10.2 mm.

Type: Holotype in Stanford University Paleo, Type Coll. no. 8520. Type locality: Trawled two miles west of Cabo Haro, Guaymas, Mexico, in 100 fathoms, on the Ariel expedition, September 2, 1960. This shell is named in honor of Captain Xavier Mendoza whose many hours of labor made the expedition possible.

Colubraria xavieri has the general shape of *C. siphonata* (Reeve) but is a heavier shell and not as elongate. The sculpture is considerably coarser than all 3 other known Panamic species. *Colubraria soverbii* (Reeve) and *C. jordani* Strong are larger and more slender with an aperture/length ratio of ⅓ or less.

Bibliography

Broderip, W. J. 1833. Proc. Zool. Soc. London: 6 (May 17).

Chemnitz, J. H. 1778. Systematisches Conchylien-Cabinet von Martini und Chemnitz, Nürnberg, vol. *10,* pl. 162, figs. 1552, 1553.

De Blainville, H. D., 1829. Faune Francaise (20) Malac., p. 118, pl. 4, D.F. 5.

Deshayes, G. P. 1843 (Lamarck) Histoire naturelle des animaux sans vertébres, Deuxiéme edition, Paris, vol. *9,* p. 646.

Hertlein, L. G. 1937. Proc. Amer. Phil. Soc. *78.* (2). 303-312, 1 pl.

Hinds, R. B. 1844. The zoology of the voyage of the H.M.S. Sulphur, London, Mollusca, pt. 1, p. 2, pl. 4, figs. 13, 14.

Keen, A. Myra. 1958. Sea Shells of Tropical West America, Stanford, pp. 348, 349, figs. 331-334.

Menke, C. T. 1828. Syn meth. Moll. p. 87.

Strong, A. M. and L. G. Hertlein, 1937. Proc. Cal. Acad. Sci., ser. 4, *22* (6): 173, 174, pl. 35, fig. 17.

PUERTO RICAN XANTHONYCHIDAE

By H. Burrington Baker

During the summer of 1939, a 2 months trip was made to Puerto Rico, to obtain animals of the native species for dissection. Because of this purpose, and because records of empty shells may be almost meaningless in the West Indies, on account of the land hermit-crabs (seen less on Puerto Rico), which migrate from the ocean to altitudes around 2000 feet and return to lay their eggs, most of my stations consist of remnants of forest away from cultivated areas, and the records (unless otherwise stated) are based on living animals. These were often rare, since my collecting was around the end of a prolonged and severe drouth, except on El Yunque, where rain fell almost every

night; this was broken by the torrential downfall of Aug. 1.

In symbols used, first capital refers to meridianal zones: E, east of 66° longitude. J. (San Juan), west to 66°30′. P. (Ponce), between last and 66°55′. W, west of last. Second (minuscule) letters differentiate lowland stations (mainly below 500 ft.): n (north) always on or near limestone (rim or caps) as are Ps and Ws (south); but e (east), w (west), Es and Js mainly without limestone, although usually with the reddish soil derived from its decomposition. Letter r (ridges) distant from limestone and mainly between 1500 and 4000 ft. elevation, because least disturbed patches of forest were on rocky summits. Little collecting done in cultivated areas, which include most of island, even on very steep slopes. Since prevailing trade winds are from northeast, Luquillo Mts. (Er) are wettest, and semidesert, limestone hills near Guanica Bay (Ps) about driest parts of island.

In the following brief descriptions of stations, the elevations (to nearest 100 ft.) largely were estimated, but have been checked (from memory) by references to the (more recent) U. S. Topographic Survey maps. The numbers (in parentheses) give locations to minutes; for example, 538,817 = 65°38′ longitude, 18°17′ latitude. Those with asteriks (*) were collected more intensively.

Ee1, south of west of Pta. Barrancas; reddish soil, 0-200 ft. (538,817), July 27. Ee2, hills near Bahía Demajagua, 2 miles south of Fajardo, 100-400 ft. (539,817), July 27.

*En1, limestone hills (Cuchilla de Santa Ines), 2 miles south of (Old) Loíza Aldea, 0-300 ft. (553,824), Aug. 25, 31, Sept. 2, 3. En2, limestone hills, just south of Loíza Aldea, 0-200 ft. (553,825), Sept. 4.

Er, Luquillo Mts. Er1, near edge of Luquillo Forest reserve, on El Yunque-Mameyes road, over 1500 ft. (545,821), July 19. *Er2, above kilometer 9.8 on same road, around 2000 ft. (546,-820), July 21, 22. *Er3, along Rio Minas and Big Trees trails below rest area, 1500-2500 ft. (547,819), July 10-18. *Er4, along El Yunque and Mt. Britton trails above this, 2500-3400 ft. (547,-819), July 12-20. Er5, along Rio Blanco above El Yunque-Nguabo road, 1500-2500 ft. (548,816), July 17.

Es, around Humacao. Es1, Pta. Lima (limestone), 0-250 ft. (541,811), July 30. Es2, around Morilla de Humacao. hill and coconut plantations, 0-300 ft. (546,809), July 30. *Es3, La Valvera, first hill south of Humacao, 300-560 ft. (549,808), July 25, 26. Es4, ridge beyond La Valvera, 300-800 ft. (550,807), July 27.

Jn, near San Juan. *Jn1, limestone hills 2 miles south of Catano, 0-300 ft. (606,825), Aug. 24-29, Sept. 12. Jn2, limestone hills south of Palo Seco R.R. station, 0-200 ft. (611,825), Aug. 30. Jn3, along road near Pta. Tocones (near limestone cliffs), 0-50

ft. (608,825), Aug. 30.

Js, Guayama, along road north, 200-500 ft. (606,800), Aug. 2.

Pn, limestone canyon of Rio Grande de Arecibo, about 10 miles southward from town. *Pnl, hills west of river (with patches of yams), 170-300 ft. (641,822), Aug. 20, 21, Sept. 9. Pn2, base of limestone cliffs, east of river, 120-170 ft. (640,822), Aug. 22.

Pr, Cordillera Central Prl, ridge north of Cerro de Punta (Calderona), known locally as "Sierra Morales," but Pfeiffer's apparently miles northward, where high limestone cap was visible; spent all morning climbing (looking vainly for *Chondropoma terebra);* collected a few ruderals about halfway up (around 2500 ft.?) but mainly in small patch of woods on north slope of summit (resident exclaimed I was first "extranjero" he had seen there in 20 yrs.), around 4000 ft. (635,810), Aug. 19. *Pr2, around crest of road Ponce-Adjuntas, 2600-3100 ft. (641,808), Aug. 3, Sept. 6 (questioned by Ponce police as "German spy"). *Pr3, Cerro El Gigante, above cliffs, 3000-3500 ft. (643,809), Sept. 7. Pr4, about 1 mile from Adjuntas on Guazas road, around 1800 ft. (643,809), Sept. 8. Pr5, east side of Rio Grande de Arecibo (called locally Las Vegas canyon), 1500-1600 ft. (644,812), Sept. 10. Pr6, around junctions Yauco-Lares-Maricao roads, near Inidiera Alta, 2500-3200 ft. (652,808), Aug. 6.

Ps, around Yauco. Psl, limestone coastal hills just east of Tallaboa, 100-400 ft. (642,800), Aug. 5. *Ps2, Cerro Capron, east of Guanica Harbor, limestone hills eastward, 0-500 ft. (656,-752,3), Aug. 4-6 (similar hills west of harbor need study!). Ps3, south of old (?) road Yauco-Sabana Grande, near Paso Limon (not on map, but limestone cliffs there should be studied), west of Rio Loco, 300-400 ft. (653,802?), Aug. 5. Ps4, garden in Yauco, 100 ft. (651,802), Aug. 7.

Wnl, limestone canyon near mouth of Rio Guajataca, 0-250 ft. (657,829), Aug. 18 (wet from rain).

Wr, around Maricao, western Cordillera Central. Wrl, above fish hatchery, 1500-1600 ft. (659,810), Aug. 11. *Wr2, southeast side (coffee) and top of Pico Montoso, 2000-2300 ft. (659,810), Aug. 12, 13. *Wr3, Maricao Forest, around Las Tetas de Cerro Gordo, 2700-3000 ft. (659,810), Aug. 14-16.

Wsl, Cabo Rojo, limestone hills at quarry, south of town, 100-400 ft. (709,804), Aug. 10. Limestone remnants between there and Ps3 need study.

Ww, near Mayaguez. Wwl, garden of Agricultural Station. Ww2, coastal hills, south end of Bahía Bramadero, on reddish soil, 0-150 ft. (710,808), Aug. 9.

In the discussions of species, the station numbers are omitted if the form was collected in those most intensively studied and seemed probably present in other patches of forest in the area.

The remarks about snails climbing, etc., apply only to daytime collecting, and are influenced by the excessive dryness before Aug. 1 and the relative wetness thereafter. The notes on animals were made in the field or under a dissecting microscope each evening. Tripartite soles (with the middle, locomotor zone demarcated by impressed grooves) are contrasted to trizonal (the usual condition in geophiles); in the urocoptids, they are unizonal, and in the pomatiids bipartite.

Cepolis (Euclastaria) musicola (Shuttleworth). Under dead leaves on ground, Es, Jn1, Js, Pn1, Pr3,6, Ps3, Wn, Wr2, Ws, Ww2; mainly lowlands but up to 3000 ft. in Cordillera Central; small shells angulate but last whorl usually becoming evenly rounded in dampish places; locally (Es, Jn, Ps3, Ws) with faint, whitish, peripheral stripe. Foot with black bosses which form stripe near sole; top of head with broad, whitish stripe.

C. (E.) musicola, var. a. Ps1,2; usually more depressed, angulate and with weaker (but similarly "remotiuscule" spaced) growth costulae than in typical *musicola,* but intergrading with it. Evidently *H. euclasta* var. gamma of Sh., 1854:38.

C. (E.) musicola euclasta (Shuttleworth). Type locality St. Thomas (ANSP. 1029, 1032, 28305-6 from Bland & Swift); usually larger than preceding and with major growth threads becoming more closely (crebre costulata) and irregularly spaced on last whorl. Also lots from St. John I., Tortola, Vieques and "Puerto Rico."

Reeve's poor figures (copied by Tryon, Man. Conch. *3*:pl. 8, figs. 66 & 65) of *C. musicola* (too high) and *euclasta* look as if the peristomes were reflexed but they are only so around the umbilicus. The Cuban *C. (E.) debilis* (Pfr., Sept., 1854) seems very similar to *C. musicola* but young shells of the former are more evenly rounded and the later whorls usually develop stronger, although similarly spaced, growth riblets; it also has high and depressed forms (ANSP. 2567-9).

A worn shell of *C. musicola* might fit the obsolete (not identified for a century) *Helix portoricensis* Pfr., 1847; although none of my 10 mm. ones are so evenly rounded, his German description, Conch. Cab.:266, pl. 120, figs. 7, 8, described the last whorl "at the periphery somewhat angular" (translation) and his figs. apparently show poorly the growth threads of this species; from a label in the ANSP., R. Swift evidently had the same idea.

C. (Bellacepolis) squamosa (Férussac). Very rare, aestivating in hanging bunches of dead leaves up to 5 ft. above ground; Eel

(dead), En1, Jn1 (dead), Pn1 (also fresh shells with holes chewed in them!), Pn2 (dead); largest shell seen. Living animal (added to 1943a:87) tinged with olive; inferior tentacles lightish.

C. (Jeanneretia?) dermatina (Shuttleworth).

Dr. Turner's (1958:158) careful identification of *C. dermatina* and her excellent figures of the type are very helpful. However, to my sorrow (1950), Shuttleworth's localities are sometimes untrustworthy, even as to island. No similar shell seen from Puerto Rico has as papilliform an apex, although some slightly approach it. It also seems different in the typical, Cuban *Jeanneretia.*

Certainly nothing like it was found in eastern Puerto Rico, although nobody's banana patch near Luquillo was invaded. But, during 5 long days around the nearby Old Loiza (En), I veritably believe that every hanging bunch of dead leaves in that area was torn apart, despite objections (also many inter- and a few in-) from wasps, in a search for *C. squamosa.*

Back in 1939-40, during preliminary sorting, 4 forms of *Levicepolis* were separated:

A. Smoothish and unicolor *C. boriquenae* (or "*boriquenus*" Turner, 1958: 164, 168, 169) from lowland Puerto Rico.

B. Cordilleran (Pr) series, with very attenuate, sharp carinae, and with shells so thin and fragile that they often warped when dried.

C. Intergrading and occurring with B, a series of slightly heavier shells with duller keels; these were considered western (Pr, Wr) *dermatina,* and would include all figs. on Turner's (1958) p. 171 (pl. 27), although figs. 1 and 2 (from near eastern border of Pr) approach form B.

D. Very variable series from (driest) western Cordillera Central, that seemed to intergrade with form C and were considered as possible hybrids or "introgression" between it and A (other lowland species found in Wr); these include *clenchi* (Turner, pl. 23, figs. 3, 4).

Forms A, B + C, and D will be treated as species of *Levicepolis.* Dr. Turner's extension of *Hemitrochus* seems inexplicable, since *Levicepolis* does not resemble the type species of the other conchologically (my synopsis, 1943a:82, mainly follows Pilsbry, 1895-3:179, whose intuitive grasp of shell characters was always far better than mine). Anatomically, *Levicepolis* seems slightly closer to *Bellacepolis.* All these forms were subarboreal, and were found mainly, when aestivating, in bunches of dead *Cecropia*

and other leaves, up to 10 ft. above the ground; perhaps because of the preceding drouth, they usually were quite rare. None was found in the Luquillo Mts. above 1500 ft. elevation.

C. (Levicepolis) boriquenae H. B. Baker. Mainly smaller than type (ANSP. 28335) and (being fresh) less glossy, but all unicolor and without major spirals or angulation; embryonic whorls (varying, but around 1) showing growth wrinkles within 1/4 whorl and approaching later ones by end (as in all *Levicepolis);* En1 (near type locality; none sexually mature but 1 with expanded peristome), Jn1, Pn1 (1943a:88), Pn2. Ps4: Approaching *clenchi;* intermediate in height of spire and in dullness, but without angulation or major spirals; 1 with supraperipheral, rufous band. Lowlands, 0-800 ft., but van der Schalie (1948:86) gives many more localities.

Dr. Turner's (1958:167) advice about the type of *C. boriquenae* is not followed, since the unscientific (but perhaps more courteous) method of substitution was not used and, if one had been so careless, type by original designation is given precedence in every version of the "rules" since 1907. Férussac first used *Helix diaphana* in 1821 (livr. 11 or 12) and also vested it in 1822 (livr. 15 & 17).

C. (L.) angulifera (Martens). Pr1: Greenish yellow, unicolor; 13.2 x 123 (16.3 mm.) with almost 5 whorls; apparently very similar to type, but from a few miles south and probably about 2000 ft. higher (Cf. Turner: 172; Gundlach's locality seems much more probable than that of Martens). Pr2: Form B with supraperipheral and subperipheral, rufous bands; form C same or with only subperipheral stripe. Pr3: Form B unicolor or with weak subperipheral band; form C (1943a:pl. 11, figs. 19-21; Turner: 171, figs. 3 & 4) with at least a trace of subperipheral and 1 also with short supraperipheral band. Pr6: Form C mainly unicolor (much like Pr1); but 1 shell approaching *clenchi* (type locality only a few miles farther west); fresh and larger, but otherwise like largest one from Wr2 (with last whorl becoming quite evenly rounded, although retaining peripheral thread, near peristome; with 2 stripes, but no whitish, peripheral band). Elevations 2500-4000 ft.

Dr. Turner's (1958-170) correction of my careless use of the oldest (supposedly) Puerto Rican name is accepted thankfully, but might not the differences in the animal of *riveroi* be due to preservation and/or use; e. g., the spermatheca (sac and stalk) of the example figured by me was distended by a spermatophore (pl. 11, figs. 19, A & B)? At the time, I was too preoccupied with the startling divergences of *Dialeuca* and *Setipellis,* and less

interested in the disappointingly uniform species of *Cepolis.*

C. (L.) clenchi (Turner). Maricao Forest (Wr3, nearest to type locality but apparently higher): mainly larger (up to maj. diam. 17.2 mm.) than Montoso series; major spirals variable but usually weak; keel variable but none carries it to peristome; color almost unicolor with faint trace of whitish peripheral band (this and more rounded last whorl least variable features of *clenchi),* through typical (rufous supraperipheral and whitish peripheral bands) to one with 2 dark bands (above and below periphery). Pico Montoso (Wr2, a few miles south of type locality): Mainly smaller; one measures 10.3 x 124 (14.2 mm.) with 4.4 whorls; varying from scarcely angulate to almost as keeled as form C, from almost without major spirals to fully as spirally striate as *angulifera,* and from almost unicolor (1 without even whitish peripheral band) to strong supraperipheral and weaker subperipheral bands; largest (empty) shell (maj. diam. 14.9 mm.) with angular thread extending to peristome. Elevations 2000-3000 ft.

Since shell intergradation with *C. angulifera* (at least) seems quite complete, this retention of *C. clenchi* as a species is mainly due to the lobe on the penial complex opposite Turner's (1958:165) label of "penis." Unfortunately, she neither figures nor describes the dividing partition and its penial papilla or verge (EP & PV in 1943a figs.), so one cannot be sure whether or not this be on the epiphallus, in which case it might be simply the "head" of a developing spermatophore ("tail" formed in flagellum). My material is not dissected yet; some (no dry shells) also are from Wr1.

Since Cepolinae Hoffmann, 1928, is a homonym, *Cepolis, Polymita, Dialeuca* and *Setipellis* might well be included with *Helminthoglypta* and *Micrarionta,* at least, in Helminthoglyptinae Pilsbry, 1939. The other well marked, American subfamilies of Xanthonychidae are Xanthonychinae (1943a:82, "A" plus *Monadenia),* Lysinoinae Hoffmann, 1928 (B) and Epiphragmophorinae Hoffmann, 1928.

References (not cited from van der Schalie, below)

Baker, H. Burrington. 1950, Naut. *63*:108.

Férussac, d'Audebard de. 1819-1832. Hist. Nat. Moll. terr. fluv., livraisons 1-28, containing Tableaux systemat. (or Prodrome) and 3 Explic. pls. See Kennard, A. S., 1942, Proc. Malac. Soc. London *25*:105-110, for dates. (Concluded by Deshayes, 1850-1, with 4th Explic. pls., 1851.)

Pilsbry, Henry A. 1882-1958. All citations utilize nos. given in 1940, Scientific contributions made from 1882 to 1939:63

pp., published by Amer. Malacolog. Union; and in Naut. *71*:105-112 (1940-1958).
Schalie, Henry van der. 1948, The land and fresh-water mollusks of Puerto Rico, Mics. Publ. Mus. Zool. Univ. Mich., no. 70:1-134, pls. 1-14. Since a very thorough bibliography was included (pp. 123-128), his nos. are utilized, with thanks.
Shuttleworth, R. F. Pages of Schalie:127, are in Diagn. 6 & 7, equal Bern. Mitth.:33-56, 89-103; dates (Mar. & June, 1854) correct.
Turner, Ruth A. 1958, Occ. Papers Dept. Moll. *2* (22):153-180.
Zilch, Adolf. 1959-1960, Handb. Paläeozool. *6* (2):1-834, I-XII (twice).

THREE SPECIES OF ODOSTOMIA FROM NORTH CAROLINA, WITH DESCRIPTION OF NEW SPECIES

By HARRY W. WELLS and MARY JANE WELLS
Department of Zoology, Duke University, Durham, North Carolina

Introduction. Fretter and Graham (1949) pointed out the ectoparasitic nature of the Pyramidellidae, a family of small gastropods that feed on certain marine invertebrates. They described the feeding apparatus and mode of life of these gastropods: "Each species feeds on a particular species of host, usually a tubiculous polychaete or a lamellibranch mollusc, obtaining attachment to the body by means of the oral sucker, piercing the body wall with the buccal stylet and sucking blood and perhaps tissue debris, by means of the buccal pump." They listed the host species of 6 pyramidellids. More recent work has focused attention on species that parasitize economically important bivalves. Cole and Hancock (1955) reported on two species that damage the European oyster, *Ostrea edulis.* On the east coast of the United States, *Odostomia (Menestho) bisuturalis* feeds on the young of the American oyster, *Crassostrea virginica* (Loosanoff 1956); and *Odostomia (Menestho) impressa* feeds on adult oysters (Hopkins 1956, Wells 1959). Another species, *Odostomia (Chrysallida) seminuda,* previously reported from scallops *(Aequipecten irradians),* has been observed feeding on the slipper shell *Crepidula fornicata* (Robertson 1957).

Allen (1958) questioned the host specificity attributed to the Pyramidellidae by Fretter and Graham. On the other hand, Berry (1954) indicated that their close host-parasite specificity provides the best explanation for the existence of many closely related

species in this family. Certainly, this is a large family, with many species separated by small, microscopic differences. The abundance of species and the seemingly minor shell differences, which have been utilized to separate them, have discouraged research on these snails. Often, it has been difficult to recognize features of shell sculpture that are taxonomically significant and separate them from intraspecific variation. Consequently, some variations from a single form have been described and named as separate species; yet small differences between species have sometimes escaped recognition.

In the course of an analysis of the fauna of oyster beds, we found that a number of small pyramidellid gastropods occurred in this habitat in the vicinity of the Duke University Marine Laboratory at Beaufort, North Carolina. *Odostomia (Menestho) impressa,* the most abundant pyramidellid in this habitat, has been treated elsewhere (Wells 1959). Three other species, belonging in the subgenus *Chrysallida,* are the subject of this report. Because these 3 species superficially resemble one another, they are easily confused. Evidently, the members of this species complex have not been distinguished previously; instead, they have been treated as a single species, *Odostomia (Chrysallida) seminuda.* The purpose of this report is to clarify the taxonomy of these forms, to distinguish between them, and to provide information on their distribution and feeding habits.

Taxonomy. Upon initial examination, this pyramidellid complex appeared to include two undescribed species, in addition to *Odostomia (Chrysallida) seminuda* C. B. Adams, 1839. However, subsequent examination showed that one species had been described previously, not from the western Atlantic, but as being from Japan. This species will be treated first; then a description of the new species will follow.

Odostomia (Chrysallida) dux Dall & Bartsch, 1906 (Fig. 4)

Dall and Bartsch (1906) described a number of new species from a collection of Pyramidellidae supplied by the Berlin Museum. This material included collections of H. and A. Adams, Paetel, Dunker, and Hilgendorf, and contained many species from Japan. From this material, Dall and Bartsch described, figured, and named a minute specimen as *Odostomia (Chrysallida) dux* (p. 350; Pl. 17, fig. 4). After its description, they noted, "It is from

Japan and belongs to the Paetel collection."

Contained in collections of Pyramidellidae in the United States National Museum and in the authors' possession are a number of specimens from North Carolina that fit perfectly the description of *O. dux*. These specimens superficially resemble *Odostomia seminuda* C. B. Adams, which also occurs on the Atlantic Coast of the United States; those in the U.S.N.M. collection had been grouped under that species.

The type specimen of *Odostomia (C.) dux* had 4 post-nuclear whorls and measured 1.8 x 1.0 mm. Corresponding North Carolina specimens with 4 post-nuclear whorls possess identical measurements. Included in these North Carolina collections are several larger specimens, with up to 5½ post-nuclear whorls, measuring up to 3.1 x 1.5 mm.

Presumably, the type specimen of *O. dux* was returned to the Berlin Museum. In view of other locality errors in the Berlin Museum material, it is quite likely that the type locality cited for *O. dux* by Dall and Bartsch was erroneous. In the same article, these authors noted specimens of 5 other species contained in the Berlin collection which apparently were also cited incorrectly as being from Japan. Three previously described species from the west coast of Mexico and one from the West Indies had been cited in the Paetel collection as having come from Japan; two species from Alaska had been incorrectly cited in the Clessin collection as having come from Japan. All the specimens recorded below were collected in North Carolina, with a single possible exception labelled "Coast of N. & S. Carolina."

Material examined (The number of post-nuclear whorls in each specimen is included in parentheses) : 2 specimens (4½, 5) from Shackleford Jetty, Beaufort Inlet, N.C.; subtidal; 1955. 1 specimen (2½), 1 dead shell (4½) dredged off Ocracoke, N.C.; 1959. 9 specimens (3, 4, 4, 4, 4, 4, 4½, 5, 5½) on shells, Beaufort, N.C.; subtidal; 1955-1956. 1 specimen (5½) labelled "Coast of N. & S. Carolina" by C. B. Adams; 1871; U.S.N.M. 24702. 1 specimen (5½) from off Cape Hatteras, N.C., U.S.F.C. Sta. 2284-86; 13 fathoms; 1885; U.S.N.M. 43967, labelled as *Odostomia cancellata* (D'Orb.). 1 specimen (4½) from 25 miles SE from Cape Fear, N.C., D2619; 15 fathoms; 1885; U.S.N.M. 97508a. 2 specimens (4½, 4½) from 17 miles SE by E ½E of Cape Lookout, N.C., U.S.F.C., D2608; 22 fathoms; 1888; U.S.N.M. 94585b. 2 dead shells (5, 5½) from off Beaufort, N.C., Eolis Sta. 21; 6-9 fathoms; 1910; U.S.N.M. Henderson Coll. (no number). 3 dead

shells ($4\frac{1}{2}$, 5, 5) from Beaufort, N.C. area; U.S.N.M. Henderson Coll. B1446.

ODOSTOMIA (CHRYSALLIDA) DIANTHOPHILA, new species (Fig. 1)

Description: Shell small, elongate-ovate, white. Nuclear whorls moderately large, deeply immersed in the first post-nuclear whorl, from which only the peripheral portion of the last oblique volution projects. Post-nuclear whorls somewhat flattened, strongly crenulately shouldered, marked between the sutures by 17 axial ribs and 5 spiral cords, the posterior two of which are a little more closely spaced than the rest. Each junction of an axial rib and a spiral cord is marked by a tubercle; the tubercles of the first and second cord are somewhat fused. The fourth spiral cord is wider and well separated from the third cord. Base moderately well rounded, attenuated, ornamented with 4 or 5 more or less distinct flattened spiral threads, reticulated by slender continuations of the axial ribs. Sculpture of the base and of the body of the last whorl near the aperture often obsolete. Aperture pear-shaped, posterior angle acute, somewhat channeled; outer lip thin, somewhat advanced in the middle in larger specimens; columella strong, curved, provided with a strong fold; parietal wall covered by a thin callus.

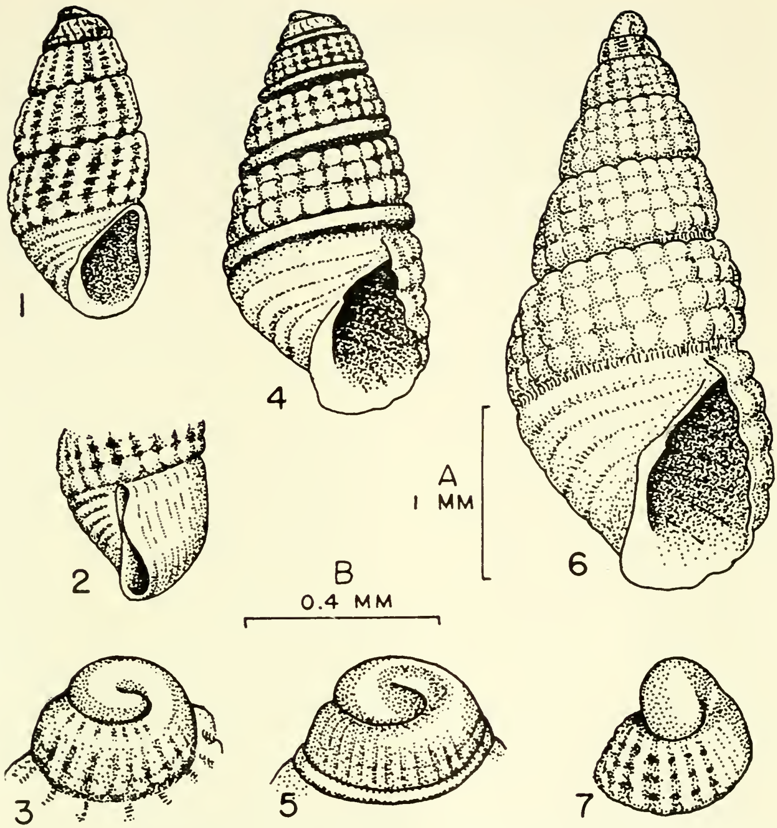
The holotype has $4\frac{1}{2}$ post-nuclear whorls and measures 1.8 mm. in length, and 0.8 mm. in width. This is the maximum size observed for this species.

This species is named *dianthophila* in allusion to its affinity for the serpulid polychaete *Eupomatus dianthus* Verrill.

Type locality: Beaufort, North Carolina (1955). The holotype (U.S.N.M. 613499) and a series of paratypes (613500) from the same collection have been deposited in the United States National Museum.

Material examined: 210 specimens collected near the Duke University Marine Laboratory, Beaufort, N.C., 1955-1956; 10 specimens dredged off Portsmouth Island, N.C., 6 fathoms, June 1959; 1 specimen dredged in Pamlico Sound, N.C., 2 fathoms, October 1960.

Comparisons of Shell Characters. Microscopic examination reveals several clear-cut differences between these three species. Whereas *O. seminuda* bears 4 rows of tubercles on each whorl (Fig. 6), *O. dux* bears 3 rows of tubercles and a smooth spiral keel, situated just above the suture (Fig. 4); and *O. dianthophila* bears 5 rows of tubercles (Fig. 1). While the axial ribs of *O. seminuda* and *O. dux* disappear above the suture, those of *O. dianthophila* may extend well below the suture onto the base. The shell of adult *O. seminuda* is larger than those of the other two species, achieving 4.0 mm. in length in contrast to maxima of 3.1 mm. in *O. dux* and 1.8 mm. in *O. dianthophila*. In addi-



Figs. 1-3, *Odostomia (C.) dianthophila:* 1, adult shell. 2, lower part of shell showing obsolete sculpture and shape of outer lip. 3, apical whorls. Figs. 4-5, *O. (C.) dux:* 4, adult shell. 5, apical whorls. Figs. 6-7, *O. (C.) seminuda.* 6, adult shell. 7, apical whorls. (Figs. 1, 2, 4, 6, to scale A; Figs. 3, 5, 7 to scale B. Drawn with the aid of camera lucida.)

tion, the shell of *O. dianthophila* is consistently more slender in proportion to its length than are those of the other two species. The nuclear whorls of *O. seminuda* form a small projecting spire, the axis of which is almost at right angles to that of succeeding whorls (Fig. 7). In contrast, the nuclear whorls of *O. dux* and *O. dianthophila* are deeply immersed in the first post-nuclear whorl, with only the peripheral portion of the last oblique volution appearing above the edge (Figs. 3 and 5).

Ecology. Feeding habits: As Robertson (1957) noted, *Odostomia seminuda* has been recorded from the valves of the bay

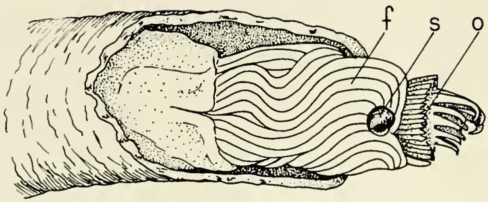


Fig. 8, *Odostomia (C.) dianthophila* (s) among branchial filaments of serpulid annelid, *Eupomatus dianthus* (preserved); parts of calcareous worm tube removed. (Drawn with the aid of camera lucida; f = branchial filaments, o = operculum of annelid.)

scallop, *Aequipecten irradians.* Robertson reported this species feeding on *Crepidula fornicata,* a sessile gastropod which utilizes a ciliary feeding method similar to that employed by bivalve mollusks. In this study, *Odostomia seminuda* has been found on the valves of the scallop *Aequipecten gibbus* dredged from off Ocracoke, North Carolina. Several specimens were found near the ventral margin of the scallops' valves, but most were located on the "ears" of the shell.

While there is insufficient evidence to justify any conclusions on the feeding relationships of *Odostomia dux,* this species has been collected in the vicinity of tubicolous polychaetes upon which it may feed. The shell of this species dredged off Ocracoke had been incorporated into a sand tube of the tubicolous polychaete, *Sabellaria vulgaris* Verrill, attached to the shell of the scallop, *Aequipecten gibbus.* The smaller, live specimen from that collection was found in a nearby crevice between other fouling organisms. Fretter and Graham (1949) have indicated that a related species, *Odostomia (Chrysallida) spiralis,* feeds on *Sabellaria* species in British waters.

Odostomia dianthophila feeds upon the serpulid annelid *Eupomatus dianthus* Verrill. The host polychaete produces white calcareous tubes that are cemented to shells, rocks, pilings, and other hard substrates; the species is distributed from New England to the West Indies and the Gulf of Mexico (Hartman 1951), and is an important fouling pest to the oyster industry in some areas. This polychaete bears a terminal plume of ciliated pinnate branchial filaments that open for feeding. When disturbed, it quickly retracts into its calcareous tube, completely withdrawing the branchial filaments which are then protected by

a stalked, trumpet-shaped operculum. A number of specimens of *O. dianthophila* have been recovered from inside the tubes of both living and preserved *Eupomatus dianthus.* They apparently were carried inside the tube when the polychaete host retracted. Most specimens were located among the branchial filaments behind the operculum (Fig. 8) ; however, two were lodged in the thoracic region of one worm (preserved). As many as three specimens of *O. dianthophila* have been found in the tube with a single worm. There can be little doubt that they were feeding on this polychaete.

Fretter and Graham (1949) have reported two species *(Odostomia unidentata, O. lukisii)* feeding on a British serpulid, *Pomatoceros triqueter,* and described this process in detail.

Generally specimens of *O. dianthophila* were found only in the larger tubes of *E. dianthus.* The *E. dianthus* typically retracts whenever there is a disturbance in its vicinity, or if it is exposed by low tides. The minute size of *Odostomia dianthophila* permits its being carried inside the calcareous tube of the polychaete when the host retracts. By this behavior pattern, the serpulid worm inadvertently affords the pyramidellid protection from would-be predators or adverse conditions.

The occurrence of this species in the tube of *Eupomatus dianthus* has a counterpart in the occurrence of two British species of *Odostomia* within the valves of pelecypods. *Odostomia scalaris* penetrates between the valves of the blue mussel, *Mytilus edulis,* and *O. eulimoides* penetrates between the valves of the European oyster, *Ostrea edulis.* In both species, the host responds by producing a thin-walled pocked that excludes the pyramidellid from the host's tissues. No such mechanism for isolating *O. dianthophila* has been observed in *E. dianthus.*

Salinity: On the basis of their occurrence in the Beaufort area, *Odostomia dux* appears to be more restricted to relatively high salinities than is *O. seminuda. Odostomia dianthophila* is much more capable of penetrating into estuarine areas than either of the other two species, having been collected among oyster shells at Cross Rock in Newport River (in the Beaufort area), and in Pamlico Sound. It has been collected repeatedly in salinities of 24 and 25 o/oo, and once in a salinity of 15 o/oo after a four week period of similarly low salinity values. However, in higher

salinities, all three species have been represented in single collections.

Reproduction: Typical pyramidellid egg masses (like those figured by Thorson 1946 and Wells 1959) belonging to *Odostomia seminuda* were observed on scallop shells collected in January, 1959. Robertson (1957) has indicated that this species spawned in July (1956) at Woods Hole, Massachusetts. As is the case with many other marine invertebrates, reproduction in *O. seminuda* appears to be directly related to water temperatures. In this case, the spawning of *O. seminuda* coincided with a temperature of about 65°F. Such water temperatures are recorded for Woods Hole in mid-July, 1956 (Bumpus, 1957). Apparently, a similar temperature occurred off Ocracoke Island, N.C., in January 1959, as one can interpolate from the hydrographic data collected at nearby lightships (Day, 1960).

There is no information available on the reproductive period of *O. dux*. Juvenile specimens of *O. dianthophila* were relatively abundant in the Beaufort area in June and July of 1955 and 1956, and several extremely small specimens (with scarcely more than the nuclear whorls) were recovered from material dredged off Portsmouth Island, N.C., in June, 1959. In view of the occurrence of its juvenile stages, *O. dianthophila* appears to spawn in late May, June, and July, exhibiting a breeding pattern in the Beaufort area similar to that of *Odostomia impressa* (Wells, 1959).

On the basis of their larval shells, there is evidently a long planktonic larval stage in *O. seminuda,* while in *O. dux* and *O. dianthophila* the planktonic stage is suppressed. However, the coincident recovery of all three species from single collections and the absence of intermediate forms indicate that the differences in the larval shells are not variations induced by different salinities.

Acknowledgments. The authors wish to express their appreciation to Drs. Harald A. Rehder and J. P. E. Morrison for facilitating their examination of collections in the U. S. National Museum. Some of the 1959 collections were made during the course of research supported by a grant (G-5838) from the National Science Foundation to Dr. I. E. Gray of the Department of Zoölogy, Duke University, and aided by the Cape Hatteras National Seashore of the National Park Service. The 1955-1956

collections were made during the course of a broad study of oyster associates at the Duke Marine Laboratory.

Summary

The taxonomy of 3 species of pyramidellid gastropods from North Carolina is treated. *Odostomia (Chrysallida) dux* Dall & Bartsch is reported from North Carolina and the suggestion made that the locality citation made for the type specimen (Japan) is incorrect. *Odostomia (Chrysallida) dianthophila* is described as a new species and distinguished from *O. seminuda* C. B. Adams and *O. dux*.

Odostomia seminuda is newly recorded from the scallop, *Aequipecten gibbus; O dianthophila* is reported as an ectoparasite of the serpulid polychaete *Eupomatus dianthus. Odostomia dianthophila* has been found inside the tubes of the retracted worm, behind the operculum among the branchial filaments. This species is successful in penetrating into estuarine areas of reduced salinity. Other aspects of their biology are discussed.

References

Allen, J. Frances. 1958. Naut. *72*: 11-15.
Berry, S. S. 1954. Amer. Malacol. Union Ann. Rept. 1954: 22.
Bumpus, D. F. 1957. U. S. Fish & Wildl. Serv. Spec. Sci. Rept., Fish. *233*: 1-132.
Cole, H. A., and D. A. Hancock. 1955. J. Mar. Biol. Assoc. U. K. *34*: 25-31.
Dall, W. H., and P. Bartsch. 1906. Proc. U. S. Nat. Mus. *30*: 321-369.
Day, C. G. 1960. U. S. Fish & Wildl. Serv. Spec. Sci. Rept., Fish. *359*: 1-114.
Fretter, Vera, and A. Graham. 1949. J. Mar. Biol. Assoc. U. K. *28*: 493-532.
Hartman, Olga. 1951. Publ. Inst. Mar. Sci. *2* (1) : 7-124.
Hopkins, S. H. 1956. Science *124* (3223) : 628-629.
Loosanoff, V. L. 1956. Science *123* (3208) : 1119-1120.
Robertson, R. 1957. Naut. *70*: 96-97.
Thorson, G. 1946. Meddel. Komm. Danmarks Fiskeri-og Havundersogelser, ser. Plankton *4* (1) : 1-523.
Wells, H. W. 1959. Naut. *72*: 140-144.

HYDROBIID SNAILS FROM LAKE PONTCHARTRAIN, LOUISIANA

By ALAN SOLEM
Chicago Natural History Museum

During ecological studies on Lake Pontchartrain in 1953 and 1954, Rezneat M. Darnell and his associates took a series of

bottom samples with a Peterson dredge. Each sample covered 0.0645 to 0.1290 square meters. The material was passed through U. S. Standard sieves (20 mesh per inch) and carefully sorted. Through the kindness of Dr. Darnell, my study of the hydrobiids was possible, with the specimens being deposited in Chicago Natural History Museum. Only two species were represented, but they are interesting from both the systematic and ecologic viewpoints.

LITTORIDINA (TEXADINA) SPHINCTOSTOMA Abbott and Ladd.
1951, Jour. Washington Acad. Sci. *41* (10): 335-338, 12 figs.

This species was reported previously from several Texas localities and Grand Isle, Louisiana. Probably it is distributed widely in the Gulf area, but has been overlooked because of its small size. Abbott and Ladd based the subgenus *Texadina* on the apertural constriction in their new species, as contrasted to the relatively larger aperture in other *Littoridina*. The same kind of constriction is found in *Probythinella protera* Pilsbry and *Amphithalamus (Floridiscrobs) dysbatus* Pilsbry and McGinty (Naut *63*: 14-15, pl. 1, fig. 7). Quite possibly this apertural construction is a convergent adaptive response to some unknown ecologic factor in the Gulf Coast estuarine environment, since it has occurred in three distinct lineages. I question the necessity of recognizing this variation by subgeneric terminology, and have refrained from creating a subgenus of *Probythinella* equivalent to *Texadina* and *Floridiscrobs*.

PROBYTHINELLA PROTERA Pilsbry. Figure 1
1953, Acad. Nat. Sci. Philadelphia, Monographs, *8*: 444-445, pl. 64, fig. 6; Pliocene of St. Petersburg, Florida.

The occurrence of a Pliocene species from Florida alive in Lake Pontchartrain is at first impression astonishing. The same Pliocene fauna includes either the same or different subspecies of the following living taxa: *Viviparus georgianus* (Lea), *Notogillia wetherbyi* (Dall), *Goniobasis catenaria* (Lea), *Helisoma scalare* (Jay), and *Gyraulus parvus* (Say).

The nearest relative to *Probythinella protera* appears to be the northern *Probythinella lacustris* (F. C. Baker). The latter species has recently been discussed by Hibbard and Taylor (1960, Univ. Mich. Mus. Paleontology, *16*, no. 1, pp. 80-84, fig. 5, pl. 4, figs. 1, 2, 5, 6) in great detail. The nearest known locality for *P.*

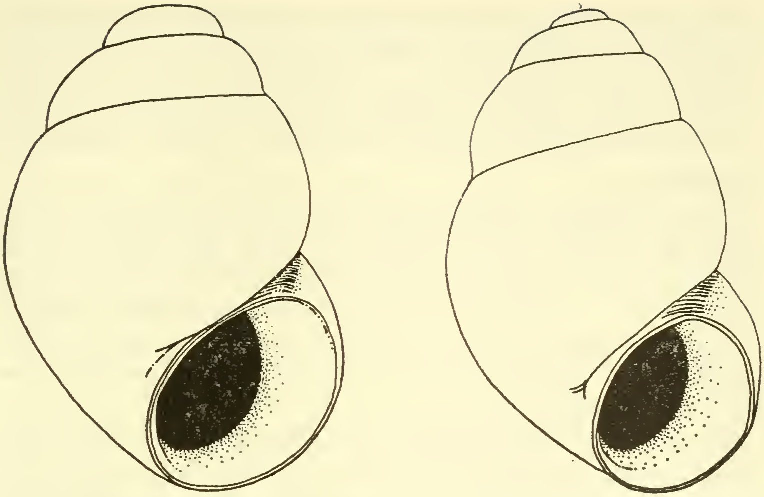


Fig. 1. *Probythinella protera* Pilsbry. Two shells from Lake Pontchartrain, La.

lacustris is in Chicot County, Arkansas. So little is known of the distribution of Louisiana snails, however, that *P. lacustris* may extend much nearer Lake Pontchartrain than is shown by plotted records. Variation within the Lake Pontchartrain *P. protera* was as great as that found in the ecologic forms of *P. lacustris* mentioned by Hibbard and Taylor. *P. protera,* although having parallel variation in form, consistently differed from *P. lacustris* in having a constricted aperture.

Distributional ecology: The unfortunate dropping of a partially sorted tray of specimens by a temporary assistant prevented full use of the population data. The following few notes summarize the retrievable information. With only partial data, statistical treatment was thought useless, and only general observations are included. The number of shells for each sample had been recorded, but not the number of each species for the dropped trays.

Forty-seven stations with a total area of 5.45 square meters yielded 6,539 identifiable specimens, 5,183 of which were *Littoridina sphinctostoma* and 1,356 were *Probythinella protera.* This produces an average population of 951 *Littoridina* and 249 *Probythinella* per square meter. The extent to which these figures represent counts of living individuals is difficult to assess.

The material had at one time been preserved in formalin and several lots had dried out. It was thus often impossible to decide whether a shell represented a recently dead shell or a living example. This factor, combined with the partial loss of data prevented detailed statistical treatment of the population structure.

The 47 samples ranged from a low of no mollusks recovered to a high of 528 examples (4,093 hydrobiids per square meter). The maximum number of *Littoridina* was 455 (3,527 per square meter) and of *Probythinella* the maximum number was 200 (1,550 per square meter). Of the 47 samples, 11 had less than 25 shells, 29 had between 50 and 300 shells, and four had more than 400 examples.

Of the 30 unmixed samples, 15 contained only *Littoridina* and 14 both *Littoridina* and *Probythinella*. Only one sample had just *Probythinella*, and in only one additional sample did the *Probythinella* outnumber the *Littoridina*.

The data are not enough to allow definite conclusions concerning the actual population structures in Lake Pontchartrain, since the samples were not evenly distributed. In the areas sampled, *Littoridina* greatly outnumbered *Probythinella*, but possibly only fringe *Probythinella* areas were sampled.

I am indebted to Dr. Darnell for permission to examine this material, and to R. Tucker Abbott for comparing the type of *Probythinella protera* with the Lake Pontchartrain specimens.

LAND SNAILS FROM MARYLAND COASTAL PLAIN

By F. WAYNE GRIMM
Michigan State University, East Lansing

Recent collecting on the Coastal Plain of Maryland has revealed the presence of 4 species of land snails not recorded previously from that region.

Triodopsis fosteri (F. C. Baker). This midwestern species has been taken at 5 stations in Wicomico Co., Md., on the Delmarva Peninsula. At all stations, it was associated with human refuse. It may have been accidentally introduced from somewhere in New Jersey, where it occurs in and around the town of Burlington. Nearly a hundred years ago, *T. fosteri* was introduced into Burlington by W. G. Binney (Pilsbry, *Land Mollusca of North America*, vol. 1, p. 832).

Maryland: Wicomico Co. Abundant in lumberyard along U.S. 13 at Salisbury. Whitehaven Ferry, near saltmarsh. Dump on Indian shell-heap immediately south of Bivalve. Valley of Nassowango Creek, 1 mile east of Waste Gate on Md. 350. Near bridge at Mill Branch, 1 mile south of Mardela Springs.

Retinella cryptomphala solida H. B. Baker. Widespread but never abundant, this strikingly beautiful snail inhabits wooded areas on either side of the Chesapeake Bay. It appears to prefer the undersides of logs in open pine woods. All specimens were collected in winter and early spring.

Maryland: Leaf mould, valley of Old Woman's Run 1 mile south of Bennesville, Charles Co. Near foundation of building, woods .8 mile east-southeast of Bryan's Road, Charles Co. Logs near highway, 2.7 miles southeast of Lexington Park, St. Mary's Co. On hill above Stony Run, Patapsco, Anne Arundel Co. Woods at roadside near Normans, 3 miles south of Stevensville, Kent Island, Queen Anne's Co.

Ventridens cerinoideus (Anthony). Seen from only 2 stations in St. Mary's Co., which occupies the southeastern half of the peninsula between the Patuxent and Potomac estuaries. It may have been introduced from coastal Virginia or farther south. *V. cerinoideus* appears to be absent from the Delmarva Peninsula.

Maryland: St. Mary's Co.—Under debris near old building at Oakville (one juvenile, dead). Dump in woods, valley of Locust Run on Md. 5 near Morganza.

Punctum smithi Morrison. This minute snail inhabits the leaf mould on heavily wooded slopes. Although widely distributed, it appears rarely. Sporadic records are scattered from the Blue Ridge eastward. To my knowledge, it has not been taken on the Delmarva.

Maryland: *Blue Ridge Province*—Chestnut Grove Road on Elk Ridge, Washington Co. *Inner Piedmont*—Valley of Bennett Creek near bridge south of Park Mills, Frederick Co. *Outer Piedmont*—Valley of Walker Branch, west end of Laurel, Prince George's Co. (near the Fall Line). *Coastal Plain*—Valley of Old Woman's Run 1 mile south of Bennesville, Charles Co. Near cemetery just east of La Plata, Charles Co. Slope 1½ mile south of Sand Gates, St. Mary's Co.

The author is indebted to Leslie Hubricht for the identification of *Retinella cryptomphala solida*.

PLEUROTOMARIIDAE IN BERMUDA WATERS

By RUTH D. TURNER
Museum of Comparative Zoology

Through the kindness of Dr. and Mrs. S. K. Roberts of Princeton University, the MCZ recently has received a young specimen of *Perotrochus quoyana* (Fisher and Bernardi) which was dredged alive in 300 fathoms, 5 miles east of St. Davids Island, Bermuda. The specimen is only 23 mm. in length and 28 mm. in greatest diameter and the embryonic whorls are in perfect condition.

At the time Dr. Roberts presented the museum with the specimen, he said that Dr. H. A. Lowenstram of the California Institute of Technology had dredged a much larger specimen from that area. On borrowing the specimen from Dr. Lowenstram, I was interested to find that it was *Entemnotrochus adansoniana* (Crosse and Fischer). This specimen was about half grown, being 58 mm. in length and 69 mm. in greatest diameter. It was dredged dead off the south shore of Bermuda in 110 fathoms.

These records extend the range of both species from the Barbados and Cuba north to Bermuda. Following are the records for these species in the collection of the Museum of Comparative Zoölogy. The generic classification used is that of L. R. Cox (1960) in the "Treatise on Invertebrate Paleontology," Part I, Mollusca 1, p. 1220.

Entemnotrochus adansoniana (Crosse and Fisher).

Pleurotomaria adansoniana Crosse and Fischer, 1861, J. de Conchl. *9*: 163, pl. 5, figs. 1-2 (Guadeloupe, Lesser Antilles, in 150 fathoms).

Blake, station 276, off Bridgetown, Barbados, Lesser Antilles (13° 03′ 50″ N; 59° 37′ 05″ W) in 94 fathoms. (alive); *Blake,* station 278, off Bridgetown, Barbados, Lesser Antilles (13° 04′ 50″ N; 59° 31′ 40″ W) in 69 fathoms (dead).

Perotrochus quoyana (Fischer and Bernardi)

Pleurotomaria quoyana Fischer and Bernardi, 1856, J. de Conchyl. *5*: 165, pl. 5, figs. 1-3 (Marie-Galante, Lesser Antilles).

Blake, station 296, off Bridgetown, Barbados, Lesser Antilles (13° 05′ 24″ N; 59° 38′ 45″ W) in 84 fathoms (alive); *Hassler,* station Sandy Bay, Barbados, Lesser Antilles in 75-100 fathoms (alive); *Atlantis,* station 2953, off Bahia Corrientes, Cuba (21°

47′ 30″ N; 84° 32′ 03″ W) in 615 fathoms (dead).

The largest MCZ specimen of *E. adansoniana* (Crosse and Fischer) is 124 mm. in length and 128 mm. in greatest diameter. The largest of *P. quoyana* (Fischer and Bernardi) is 51 mm. in length and 57 mm. in greatest diameter.

PETER OLAUS OKKELBERG, 1880-1960

To his colleagues and the many students with whom he worked, the death of Professor Okkelberg on September 13, 1960, represents a real loss. He was born near Goodhue, Minnesota, November 12, 1880, and received his Ph.D. from the University of Michigan in 1918. His 50 years of service at the same University, prior to his retirement in 1951, centered mainly in the teaching of embryology and comparative anatomy. While he was responsible for the training of thousands of premedical students, he did participate in basic research involving many graduate students working towards higher degrees. Among the 23 students who completed their doctorate under his direction, one wrote a dissertation in malacology.

He donated his mollusk collections to the Museum of Zoology in 1930, soon after he became one of the key administrative officers in the University (Secretary, Assistant Dean, and Associate Dean in the Graduate School between 1933 and 1951, successively). His collections reflect a long and wide interest in mollusks; they include land, fresh-water and marine shells from most of the places he worked, including the biological stations in Beaufort, North Carolina, and Woods Hole, Massachusetts. He also collected at various times in Minnesota, Wisconsin, Colorado, Wyoming, Ontario, New York, Ohio and Michigan.

In the summer of 1929, Dr. Okkelberg accompanied William J. Clench on a University of Michigan expedition for Calvin Goodrich to Georgia. One of the main objectives of this trip was to procure pleurocerid snails for studies in which Mr. Goodrich was then engaged. As often happens in field work, this expedition did not accomplish the anticipated goals. The area in central Georgia has a poor mollusk fauna. They had assumed that it had simply not been explored previously; however, they discovered that a large schistose belt crossed that region from northeast to southwest. The scarcity of lime resulting from this

condition made collecting in those streams very disappointing. Furthermore, heavy unexpected rains produced such unfavorable situations that a change in their original plans was necessary. A side trip to Florida and Cuba was added to their itinerary. In a conversation with Dr. Okkelberg later, he indicated that he thoroughly enjoyed this field trip. He frequently referred to it as a cherished memory in his zoological career. Among the substantial collections made by Clench and Okkelberg, Goodrich found 3 new varieties of pleurocerids as well as a good series of topotypes.

Dr. Okkelberg's interests in malacology were not only reflected in his collections over an extended period but in the number of occasions that he served on doctoral committees of malacology students. He himself directed the work of Margaret E. Whitney who later published her work under the following titles: "Some observations on the reproductive cycle of the common land snail, *Vallonia pulchella.* Influence of enviromental factors" (Proc. Indiana Acad. Sci., *47*: 299-307, 1938) ; and "The hermaphroditic gland and germ cells of *Vallonia pulchella* Müll." (Pap. Mich. Acad. Sci., Arts & Letters, *26*; 311-338, 1941).

His dedication to high standards and his interest in malacology were most helpful. His devotion to students and his inspiring assistance to them was evident to me especially when he arranged to instruct me for a semester in his own laboratory at a time when a formal course in malacology was not given on our campus.—HENRY VAN DER SCHALIE, Museum of Zoology, Ann Arbor, Mich.

FRANCIS NOYES BALCH
1874-1960

Francis Noyes Balch of Boston, Massachusetts, a co-founder of the Boston Malacological Club, died October 14, 1960, at the age of eighty-six. Chronic illness had kept him confined to his home for several years before his death.

Mr. Balch was a man who combined with distinction both a vocation and an avocation. His vocation was the Law which he both practiced and taught. For five years he served as associate professor of business law at the Harvard Graduate School of Business Administration. At one time or another he was a mem-

ber of the Massachusetts Constitutional Convention of 1916-17; of the Boston Finance Commission; and of the Massachusetts Legislature.

For avocations he had both malacology and ornithology. Experience immediately after graduation from Harvard College in 1896 included work at Woods Hole in 1896 and with the U.S. Fish Commission in 1897. Cold Spring Harbor in New York came next in 1898 and 1899. Here Mr. Balch was especially concerned with nudibranchs, reporting one new genus and two new species.

Throughout a long lifetime, vocation and avocations touched at many points as is evidenced by a list of his interests: coloration and distribution of Mollusca; chromatophores of cephalopods; the nudibranchiata; bird migration and coloration; heredity, eugenics and crime; anthropology and pre-history.

The Boston Malacological Club, whcih celebrated its 50th anniversary this year (1960) is largely indebted to Francis Balch's interest and initiative. He was the Club's first vice-president and second president. During subsequent years he shared in the Club's activities until increasing physical disability rendered this impossible. In recognition of his many contributions to the club a memorial fund was set up by the members.

The following is a list of Mr. Balch's malacological publications with new species described by him:

List of marine Mollusca of Coldspring Harbor, Long Island, with descriptions of one new genus and two new species of nudibranchs. Proceedings, Boston Society of Natural History, vol. *29,* no. 7, Oct. 1899, pp. 133-162. *Polycerella davenportii,* new species (Polyceridae). *Corambella,* new genus (Corambidae). *Corambella depressa,* new species.

Remarks on certain New England chitons with description of a new variety. Nautilus *20* (6), Oct. 1906, pp. 62-68. *Tonicella ruber* (Lowe) var. *index,* new.

On a new Labradorean species of *Onchidiopsis,* a genus of mollusks new to eastern North America; with remarks on its relationships. Proceedings, U.S. National Museum, no. 1761, vol. *38,* Oct. 6, 1910. *Onchidiopsis corys,* new species.—MERRILL E. CHAMPION.

NOTES AND NEWS

JEANNE SANDERSON SCHWENGEL—Dr. Jeanne S. (Mrs. Frank R.) Schwengel died suddenly, February 17th, at the age of 71,

while attending the meetings of the St. Petersburg Shell Club. She will be missed sadly by all her many friends and scientific colleagues. An obituary will appear in a future number.

—Editors.

Yunquea monteplatonis.—*"Suavitas" monteplatonis* Pilsbry, 1931-21, from Mt. Platon (Piton?), Haiti, is a larger shell than *Y. denselirata,* with more arcuate and thickened, basal peristome; Cf. *Helix effusa* (Pfr.) Tryon, Man. Conch. 2: pl. 51, figs. 30-32 (ANSP. 12147 from Bland). With this addition, a **new subfamily Yunqueinae** (in Sagdidae) is proposed; Zilch, 1960:589, wisely questioned the inclusion of *Yunquea* in Aquebaninae, since it is different enough to be made a separate family, at the bases of the Sagdidae and Oleacinidae. Like *Aquebana, Yunquea* lacks lamellae but, in form of shell, also approaches *Odontosagda,* of which *"Y. denselirata"* van der Schalie, 1948:71, pl. 6, fig. 5, apparently is a Puerto Rican species.—H. Burrington Baker.

The status of Vitrinizonites uvidermis Pilsbry.—*V. uvidermis,* according to Pilsbry (Land Moll. N. Amer. II, pp. 347-349.), differs from *V. latissimus* (Lewis) in lacking the calcareous layer of the shell, and in having much larger teeth in the radula. I recently examined the radulae of specimens of *V. latissimus* from Little Haw Knob, Unicoi Mtn., Monroe Co., Tennessee. They were found to have teeth larger than those of *V. uvidermis* from Clingmans Dome. The difference between the teeth on the two ends of the radula was as great as the difference reported for the two species by Pilsbry. The teeth were small in the specimens of *V. latissimus* which Pilsbry examined because the animals were immature.

Frequently the shells of zonitid snails in lime deficient areas become thin when old. The shells of *Mesomphix* will sometimes collapse in the fingers when attempting to remove the animal. Possibly they extract lime from the shell to use in egg production.

I believe *V. uvidermis* to be only very old *V. latissimus.* I have collected *V. uvidermis* many times but never have seen a young one.

The teeth of *V. latissimus* are large enough so that they can give a painful pinch when carried in the hand, but I never had them draw blood.—Leslie Hubricht.

PUBLICATIONS RECEIVED
1960

Habe, Tadashige & Taiji Kikuchi. Fauna and flora of the sea around the Amakusa Marine Biological Laboratory, Part I, Mollusca. 70 pp. Amakusa Mar. Biol. Lab.

Hubricht, Leslie. The cave snail, *Carychium stygium* Call. Trans. Ky. Acad. Sci. *21*:35-38, figs. 1-2.

Karlin, Edward J. & John A. Naegele. Biology of the Mollusca of greenhouses in New York state. Cornell Agric. Exper. Sta., Memoir 372, 35 pp., 16 figs.

Knight, J. Brookes, L. R. Cox, A. Myra Keen, A. G. Smith, R. L. Batten, E. L. Yochelson, N. H. Ludbrook, Robert Robertson, C. M. Yonge, and R. C. Moore. (Moore, Raymond C. & Charles W. Pitrat, editors). Treatise on Invertebrate Paleontology, Part 1, Mollusca 1. General features, Scaphopoda, Amphineura, Monoplacophora, Gastropoda: general features, Archaeogastropoda and some (mainly Paleozoic) Caenogastropoda and Opisthobranchia. 351 + xxiii pp., 216 figs. Geol. Soc. America & University Kas. Pres.

Ladd, Harry S. Origin of the Pacific island molluscan fauna. Amer. Jour. Sci. *258-A*:137-150, 3 figs.

Okutani, Takashi, & Tadashige Habe. *Pterotrachea coronata* (Forskäl) a heteropod mollusc from South African waters. Ann. Natal Mus. *14*:513-515, 2 figs.

Riedel, Adolf. Die Gattung *Lindbergia* Riedel nebst Angaben über *Vitrea illyrica* (A. J. Wagner). Ann. Zool., Polska Akad. Nauk *18:333- 346,* 19 figs.

Turner, Ruth D. Land shells of Navassa Island, West Indies. Bull. Mus. Comp. Zool. *122*:233-244, pls. 1-7.

Verdcourt, B. East African slugs of the family Urocyclidae. J. East Africa Nat. Hist. Soc. *23:200-209,* figs. 1-4.

Zilch, Adolf. Gastropoda von Wilhelm Wenz, Teil 2, Euthyneura. Handb. Palaeozoologie 6:401-600, figs. 1435-2111 (Lief. 3: DM. 84); 601-834, i-xii, figs. 2112-2515 (Lief. 4: DM. 144). Gebrüder Borntraeger, Berlin-Nikolassee.

Zimmerman, James A. Pleistocene molluscan faunas of the Newell Lake deposit, Logan County, Ohio. Ohio J. Sci. 60:13-39, figs. 1-19.
